Montana Nonpoint Source Management Plan

Prepared by:

Montana Department of Environmental Quality
Water Quality Planning Bureau
Watershed Protection Section
P.O. Box 200901
Helena, MT 59620-0901

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Montana Department of
ENVIRONMENTAL QUALITY

Brian Schweitzer, Governor

P.O. Box 200901 • Helena, MT 59620-0901 • (406) 444-2544 • www.deq.mt.gov

Preface to the 2007 Montana Nonpoint Source Management Plan

Dear Reader,

Addressing water pollution from inadequately controlled runoff is one of Montana's greatest water quality challenges. As you'll learn in this document, all Montanans have a stake, a role, and a responsibility in addressing this issue.

Montana's approach to managing polluted runoff from diffuse sources, also known as nonpoint pollution sources, is largely through voluntary cooperation. It involves changes in our behaviors and management practices. Sources of polluted runoff include: bacteria from pet and animal wastes; pesticides and herbicides from lawns and fields; sediment from roads and disturbed soil; and nitrogen and phosphorus from septic systems and fertilizers. All of these pollutants can harm aquatic life, increase costs for domestic water supplies, and impact recreational use. Montana is lucky to have a broad group of willing partners who can develop and implement solutions to nonpoint source pollution at the local watershed level.

The Montana State Constitution states that "All persons are born free and have certain inalienable rights. They include the right to a clean and healthful environment and the rights of pursuing life's basic necessities, enjoying and defending their lives and liberties, acquiring, possessing and protecting property, and seeking their safety, health and happiness in all lawful ways. In enjoying these rights, all persons recognize corresponding responsibilities." Nonpoint source water pollution is both a national and state-wide issue that threatens our opportunity to fully enjoy a clean and healthful environment. Additionally, as a headwaters state, we have a national responsibility to ensure that citizens living downstream can also count on receiving clean water from Montana.

This document provides information on causes of, effects on, methods of, and resources to address polluted runoff. Please join us in the challenge of ensuring a clean and healthful environment by working to address water pollution by changing our daily activities on the land.

Sincerely,

Richard H. Opper
Director

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EXECUTIVE SUMMARY

Purpose and Scope

This document describes the Montana Department of Environmental Quality's (DEQ) updated strategy for controlling nonpoint source (NPS) water pollution, which is the state's single largest source of water quality impairment. NPS pollution is contaminated runoff from the land surface that can be generated by most land use activities, including agriculture, forestry, urban and suburban development, mining, and others. Common NPS pollutants include sediment, nutrients, temperature, heavy metals, pesticides, pathogens, and salt.

The purpose of the Montana NPS Pollution Management Plan (Plan) is: 1) to inform the state's citizens about NPS pollution problems, and 2) to establish goals, objectives and both long-term and short-term strategies for controlling NPS pollution on a statewide basis.

The goal of Montana's NPS Management Program is to protect and restore water quality from the impacts of nonpoint sources of pollution in order to provide a clean and healthy environment.

Montana Water Resources

Montana's land and water resources are summarized in **Section 2** of the Plan. Montana is the fourth largest state in the nation in area, but ranks 44th in population. Almost a third of the state's 93 million acres is owned by the federal and state governments. In addition, Indian trust, tribal, and allotted lands in the state total approximately 4 million acres. Agriculture, recreation and tourism, forest products, and mining have formed the traditional base of Montana's economy. However, in recent years, urban and suburban development, real estate sales, and small businesses have become significant components of the state's economy. The availability and distribution of high quality water have been important factors in the settlement of the state, with most of the state's population concentrated along major river valleys. Montana ranks third in the United States in the number of stream miles, sixth in the number of lakes, and eighth in total lake acreage. It has been called the "Headwaters of the Continent" and is the only state that sends water to three oceans.

Montana's streams range from large perennial rivers that flow year around, to small intermittent streams that only flow when recharged by ground water or precipitation, to ephemeral streams that only flow sporadically during runoff events. Lakes in the state range from large natural freshwater systems to saline basins that may completely evaporate during the course of the year. Montanans use approximately 8.1 billion gallons per day of these surface water resources for a variety of residential and commercial uses, including public water supplies, household domestic water, irrigation, livestock, industry, and mining. Irrigation accounts for 97 percent of this supply, making it, by far, the primary user of the state's surface waters. Most of the state's surface water supply is already legally allocated, or is in the process of being allocated. The demand for high quality water is expected to increase in the future as the state's population and industries continue to grow.

Montana’s wetlands and riparian areas are another important component of the state’s water resources. Wetlands and riparian areas play a significant role in protecting water quality and reducing or eliminating the adverse impacts of NPS pollution by providing natural buffers between uplands and adjacent water bodies. Besides improving water quality, wetlands and riparian areas provide stream shading, floodwater attenuation, shoreline stabilization and erosion control, ground-water recharge, and habitat for a variety of aquatic, semi-aquatic, terrestrial, migratory, and rare species. Loss of these systems allows for a more direct contribution of NPS pollutants to receiving waters. These numerous and diverse benefits of wetlands and riparian areas make their protection essential. At this time, accurate maps do not exist for Montana's wetlands as they do for streams and lakes. As a result, only estimates of their aerial extent are available. Draining, dredging, and filling activities that have occurred since settlement began have destroyed about 30 percent of the original wetland acreage in Montana.

Ground water is a valuable resource in Montana that is vulnerable to the effects of NPS pollution. Depending on the setting, ground water can be intricately linked with surface water. Alternately, ground water may be the primary water supply in areas where surface water is scarce. Increased awareness of the connection between ground water and surface water at the national and state levels has led to interest in managing these waters as one resource. Measures taken to safeguard surface waters will ultimately benefit ground-water supplies and vice versa. However, the concealed nature of ground water presents unique challenges for the protection of this resource.

Approximately 188 million gallons per day of ground water are used for residential and commercial purposes in Montana. Irrigation and public water supplies are the major users of Montana’s ground water, at 44 percent and 30 percent, respectively. Although ground-water supplies make up a smaller portion of the state’s water use in comparison to surface waters, it is important to note that ground-water supplies are the primary source of drinking water for rural domestic water supply as well as public water systems. Concern about the rate and scale of ground-water quality impacts is increasing in the state, for the most part due to the rising use of wells for drinking water and individual septic systems for on-site waste disposal. Septic systems, also known as on-site subsurface wastewater treatment systems, are of particular concern in the rapidly developing areas of the state because there are no specific programs in place to regulate the maintenance and operation of private individual septic systems.

Nonpoint Source Pollution Problems and Causes

NPS pollution is the leading cause of surface water impairments in Montana, accounting for approximately 90 percent of the documented problems in streams and 70 percent of the problems in lakes, reservoirs and wetlands. According to Montana Department of Environmental Quality’s (DEQ) 2006 Statewide Water Quality Assessment, sediment, nutrients, water temperature problems, heavy metals, primarily from nonpoint sources, are responsible for the greatest number of impaired stream miles in Montana relative to other causes of water quality impairment. The pollutants affecting the greatest number of lake and reservoir acres are metals, particularly mercury and lead, sediment, polychlorinated biphenyls (PCBs), and nutrients. These pollutants are generated by a variety of land uses, including farming, grazing, logging, mining, roads, urban and suburban development, and many other activities. The 2006 statewide water quality assessment further concluded that agriculture, including dryland farming, irrigated crop production and grazing, hydromodification (actions that change natural flow patterns including channel straightening, channel relocation, and dams), habitat modification, atmospheric deposition, and resource extraction (mining) are among the leading nonpoint sources of stream and lake water quality impairments.

Water Quality Management Framework

Montana's NPS Program framework is described in **Section 3** of the Plan. Montana DEQ's authority for controlling NPS pollution is contained in the federal Clean Water Act and the Montana Water Quality Act. DEQ has responsibility for maintaining and improving water quality in nearly 50,000 miles of perennial streams, more than 100,000 miles of intermittent streams, and nearly 700,000 acres of lakes, reservoirs and wetlands.

Protection and management of Montana's water quality is accomplished through a series of component parts, including standards and classification, monitoring and assessment, restoration planning and development of Total Maximum Daily Loads (TMDLs), restoration priority setting, implementation, and adaptive management.

All surface and ground waters of the state are classified for a variety of beneficial uses, such as drinking water, agricultural and industrial water supply, fisheries and aquatic life, and recreation. The Montana Water Quality Standards describe water quality goals, set limits for specific pollutants, prohibit activities and practices that can degrade water quality, and establish non-degradation requirements for waters whose existing high quality exceeds the standards. The condition of the state's surface waters are determined through monitoring and assessment, and waters not meeting standards are identified, listed and prioritized for development of quantitative pollutant reduction strategies (known as Total Maximum Daily Loads) and Water Quality Plans (WQPs). The State's Integrated 303(d)/305(b) Water Quality Report for Montana is the primary document for state-wide reporting of water quality.

Water quality/TMDL planning in Montana is done on a watershed (an area that drains into a water body such as a river or lake) basis. Most of the TMDL planning is done at the 4th level Hydrologic Unit Code (HUC), which in Montana usually has a size of more than 300,000 acres. Montana DEQ has traditionally promoted and supported a locally based approach to water quality management planning and improvement, with leadership provided by watershed groups and conservation districts and active participation by all watershed stakeholders. Adaptive management, a repeating cycle of planning, implementation, monitoring and evaluation, and then fine tuning is a common component of these locally based watershed restoration plans (WRPs). Adaptive management allows progress to be made in restoring water quality, while gathering additional information to improve the understanding of NPS pollution cause and effect relationships. This allows for modifying activities to more effectively meet established goals.

Nonpoint Source Pollution Control Strategy

In order to accomplish the goal of the NPS Program, Montana uses the principles of: supporting local conservation activities; completing comprehensive assessments as part of the Water Quality Planning process; improving collaboration with other programs, agencies and organizations; and improving the connection between assessment, planning and implementation using adaptive management.

Montana's strategy for addressing NPS pollution includes protection of clean water and restoring waters that do not meet state standards. Protection of clean water that meets or exceeds standards is accomplished through state-wide education and outreach (E&O) activities. In protecting existing clean water, the NPS Program emphasizes the use of appropriate management practices also referred to as Best Management Practices (BMPs).

For waters that are not meetings standards the state's strategy is to restore those waters through the development and implementation of science-based, locally supported WRPs. In the case of impaired waters, application of BMPs may not be sufficient to restore all beneficial uses. The WQPs and associated TMDLs identify the point source (controlled through discharge permits) pollutant loads and NPS pollutant loads necessary to meet water quality standards. The NPS load allocations are expected to be met through the use of reasonable land, soil and water conservation practices identified in the WQPs. These land, soil and water conservation practices include, but are not limited to BMPs. Again, adaptive management plays an important role in the restoration process.

Section 4 of the Plan provides specific actions for the significant categories of NPS pollution. The categories are defined as: agriculture, forestry, diffuse urban and suburban pollution, resource extraction and contaminated sediment, hydrologic modification (dams, water withdrawals, stream channel changes, etc.), recreation, atmospheric pollution, and as an emerging source, climate change. **Section 4** of the Plan also includes the E&O strategies for addressing nonpoint source pollution.

Montana's Nonpoint Source Control Five-Year Action Plan

The short-term (five-year) goal of Montana's NPS Management Program is to demonstrate significant progress in protecting and restoring the water quality of Montana from nonpoint sources of pollution as measured by achieving the actions outlined in **Section 5** of the plan.

Resource Specific Five-Year Goals for the State's Nonpoint Source Plan	
Five-Year Goal	**Measurable Outcome**
Complete Water Quality Plans and necessary TMDLs	Number of Water Quality Plans and pollutant/waterbody TMDLs completed
Conduct water quality assessments state-wide	Number of updated water quality assessments for state waters
Review/update Integrated Water Quality Report (305(b)/303(d))	Updated Integrated Reports – 2008, 2010, 2012
Reference site monitoring and assessment	Number of reference sites monitored and assessed

Resource Specific Five-Year Goals for the State's Nonpoint Source Plan	
Five-Year Goal	**Measurable Outcome**
Increase DEQ internal monitoring support for TMDL program	Water quality monitoring data for development of TMDLs
Work with watershed groups to develop watershed restoration plans	Number of watershed groups with watershed restoration plans
Implement restoration projects identified in Water Quality Plans/TMDLs	Number of restoration projects implemented
Monitor 319 restoration activities for effectiveness and pollutant load reductions	Monitoring SAPs, water quality data collection and assessment, estimates of load reductions
Establish a statewide monitoring strategy for monitoring of 319 and other watershed restoration activities for practice effectiveness, load reductions, and in-stream water quality achievements.	A statewide project-monitoring strategy, monitoring SAPs, estimates of load reductions, volunteers conducting watershed monitoring.
Conduct 5-year reviews of completed and implemented TMDLs	Number of 5-year reviews conducted
Collaborate with federal, state, and local agencies to promote conservation tillage (no-till, direct seed),vegetated filter strips, and riparian buffers	Acres of conservation tillage (no till, direct seed), miles of vegetated filter strips, and riparian buffers, participants at conservation tillage workshops
SMZ review for protection of water quality, 2 facets: 1)restored watershed monitoring 2)collaborative research projects (i.e. DNRC & Plum Creek)	Number of reviews completed, number of research projects completed
Overlap priority areas with USFS/DNRC using GIS for coordinating watershed planning process (needs assessment versus existing budgets)	Number of Forests with completed GIS overlay
Work with MSU Extension, DNRC, USFS R8, NRCS, and BLM to develop a targeted list of BMPs for grazing (those that achieve water quality standards)	Agencies participating in implementation of water quality BMPs, number of acres grazed with BMPs that are protective of water quality
Provide reviews and comment on outside agency proposed projects	Number of reviews completed
Develop, maintain and enhance Clean Water Act Information Center public access to data system	System operable and available to public
Administer STORET water quality database system	STORET uploads of DEQ monitoring data every 6 months, all relevant DEQ in-stream monitoring data available in STORET
Administer web-based STORET Interface Module for non-DEQ STORET data submittals	Continued and expanded use of web-SIM by partners external to DEQ, technical assistance to outside users
Initiate monitoring project for "large rivers" (e.g. Missouri, Yellowstone)	Development of monitoring protocols for large rivers

Policy Directed Five-Year Goals for the State's Nonpoint Source Plan	
Five-Year Goal	**Measurable Outcome**
Provide 319 funding to projects that implement NPS and TMDL water quality restoration strategies	Number of projects implemented
Develop and implement DEQ water quality improvement MOUs with agencies including USFS, BLM, DNRC, MDT, and MFWP	Number of MOUs signed, clarified agency roles and responsibilities for addressing NPS pollution

Policy Directed Five-Year Goals for the State's Nonpoint Source Plan	
Five-Year Goal	**Measurable Outcome**
Assist in efforts to develop a cumulative impact assessment strategy for ground-water impacts in high density septic/development areas	Septic system cumulative impacts assessment strategy.
Assist in the review of subdivision storm water rules.	Potential revisions to DEQ 8.
Implement collaborative monitoring processes with federal, state, and local agencies on federal and state land projects, focusing on riparian zone management in achieving water quality standards	Number of SOPs/SAPs developed with DEQ collaboration, number of contracts/leases renewed with riparian zone targets & water quality monitoring
Continue water quality participation in the ITEEM process by collaborating with the IRTWG group	Projects reviewed under ITEEM
Develop numeric nutrient water quality standards and implementation procedures for surface waters	Numeric nutrient water quality standards and implementation procedures for flowing waters
Develop technical basis for a lake classification system based on nutrient status	Scientifically defensible assessment tool for developing lake nutrient standards
Promulgate numeric standards for all pesticides identified in Montana ground and surface waters.	Adoption of numeric standards for all pesticides within 2 years of DEQ notification of detection in state waters
Develop biocriteria for wadeable streams	DEQ acceptance of accurate, defensible biological assessment tools
Develop Standard Operation Procedures (SOP) for monitoring intermittent streams	SOP adopted, number of streams assessed using SOP
Review and recommend revisions or updates to Montana's Ground-Water Plan	DNRC recommended Ground-Water Plan revisions to EQC
Form a MS4 task force to promote and coordinate storm water management activities	Number of meetings, number of communities participating, number of LID demonstration projects

Education and Outreach Five-Year Goals for the State's Nonpoint Source Plan	
Five-Year Goal	**Measurable Outcome**
Provide support and promote the development and coordination of watershed groups through MWCC activities, training workshops, advertising campaigns, etc.	Amount of funding going towards MWCC or advertising activities, number of workshops held, number of participants, number of watershed groups using advertising and promotional resources
Support the certification of volunteer monitors in watershed groups	Number of watershed groups with certified volunteer monitoring programs, number of sampling events, increased quality and reliability of data based on appropriate QA/QC protocols
Improve DEQ website for public access to information on NPS Program	Hits on DEQ website, public feedback of new DEQ website
Develop educational campaign: Urban growth and development issues (i.e. storm water runoff, septic system maintenance, transportation infrastructure, low impact development)	Number of local governments addressing NPS issues, number of communities with NPS education & outreach activities

Education and Outreach Five-Year Goals for the State's Nonpoint Source Plan	
Five-Year Goal	**Measurable Outcome**
Develop educational campaign: Riparian and wetland buffer protection	Number and types of ad campaigns. Delivery of message, numbers and acres of wetlands and miles of riparian areas protected.
Develop educational campaign: Small farm and ranch conservation. Work with NRCS, DNRC, MSU Extension, and Farm Bureau	List of priority focus areas, number of land owners attending workshops, distribution of campaign materials, number of small farm and ranch management plans developed
Work with Statewide organizations (i.e. MEEA, Project WET) to establish and expand water curriculum in schools	New water resource curriculum, number of teachers using curriculum, number of students participating in workshops or trainings, hits on MEEA and Digital Library for Earth System Education (DLESE) websites
Develop and promote BMP training for road maintenance personnel using Local Technical Assistance Program (LTAP) and other venues	Number of trainings held, number of participants trained, transportation funding allocated to BMP installations or activities.

Nonpoint Source Program Evaluation

Montana DEQ has established a multi-faceted approach to evaluating the overall effectiveness of its NPS Pollution Management Plan which is outlined in **Section 6**. This strategy includes 1) monitoring of statewide water quality trends, watershed evaluation of water quality improvements and individual NPS control project effectiveness, 2) evaluating indirect measures such as the acres of wetlands and riparian areas protected through easements and buffers, and 3) evaluating public E&O components. Montana DEQ will periodically review this information to evaluate program effectiveness, to determine what is working and what is not, and to identify the need for program adjustments.

Additional Information Resources

The final section of the Montana NPS Pollution Management Plan describes additional information resources pertaining to NPS pollution, including agency publications and web resources, and materials developed by the university system, watershed groups, and non-profit organizations. The appendices to this report include more detailed information on controlling NPS pollution from various land use activities, cooperating partners, funding resources, etc.

SECTION 1.0 INTRODUCTION

This Plan documents the State of Montana's updated strategy for managing and controlling nonpoint source (NPS) water pollution. NPS pollution is pollution that originates from a variety of land use activities over generally large areas and which is transported to streams, lakes, wetlands and ground water via precipitation, snowmelt and storm water runoff. Nonpoint pollution may also come in the form of substances which erode directly into surface waters or which are aerially transported and deposited on land and water. Common nonpoint pollutants include sediment, nutrients (nitrogen and phosphorus), temperature changes, heavy metals, pesticides, pathogens, and salt.

NPS pollution is a significant problem in Montana, comprising the single largest cause of water quality impairment on a statewide basis. As many as 65 percent of Montana's assessed rivers and streams and up to 80 percent of its lakes, reservoirs and wetlands, fail to meet state water quality standards largely as a result of NPS pollution impacts (DEQ 2006).

The purpose of the *Montana Nonpoint Source Pollution Management Plan* is to:

- Inform Montana citizens about the causes and water quality effects of NPS pollution.
- Set priorities for controlling NPS pollution on a statewide basis.
- Identify long-term strategies for restoring water quality affected by NPS pollution
- Describe a set of focused, short-term actions (five-year action plan) for attaining the statewide NPS pollution control program goals.

Authority for controlling NPS pollution on a national level is provided in the federal Clean Water Act (CWA). The original CWA, passed in 1972, established a national framework for protecting and improving water quality. The overall goal of the CWA is "to restore and maintain the chemical, physical and biological integrity of the Nation's waters." Specific objectives include the elimination of discharges of pollutants and attainment of interim water quality levels that will protect fish, shellfish and wildlife, while providing for recreation in and on the water wherever possible.

Implementation of the CWA in the early decades following its passage resulted in considerable national water quality improvements through improved treatment requirements for industrial and municipal wastewater discharges (or point sources).

Following these early successes in controlling point source pollution, the CWA was amended in 1987 to require States to develop plans for controlling nonpoint sources of water pollution. Montana's Nonpoint Source Pollution Control Program was established shortly after the passage of the Section 319 amendments to the federal CWA in 1987. Section 319 of the CWA, entitled "Management of Nonpoint Sources of Pollution," provides grant monies to states for a wide variety of NPS control activities ranging from technical and financial assistance, education and training, to technology transfer, on-the-ground demonstration projects, and monitoring to evaluate the effectiveness of NPS control projects. In order to receive Section 319 funding, states must complete an assessment of their NPS pollution problems (updated biennially as part of the

305(b)/303(d) reporting process described below) and develop a management program to address the problems identified in the assessment report.

Other new sections of the CWA passed in 1987, Sections 303(d) and 305(b), require states to monitor and assess statewide water quality conditions, identify and list water bodies that fail to meet water quality standards, and prepare Water Quality Plans (WQPs) for restoring water quality. These WQPs must include quantitative limits for each of the pollutants of concern known as Total Maximum Daily Loads. Most of Montana's water quality impairments reflected on the 303(d) list are a result of NPS pollution.

DEQ is the state agency with responsibility and authority for developing and implementing water quality protection and improvement programs. Montana DEQ maintains a point source pollution control program known as the Montana Pollutant Discharge Elimination System (MPDES) which is aimed at protecting water quality in water bodies receiving point source discharges from sewage, industrial or other wastes. The programs and procedures described in this *Montana Nonpoint Source Management Plan* are the state's primary vehicle for controlling and preventing water quality impacts from NPS pollution.

In May 1996, the EPA provided major new guidance for states in developing their NPS management programs. This guidance required states to address nine key elements in their programs. Montana incorporated those nine specific elements into its 2001 Nonpoint Source Management Plan and includes them in this 2007 plan. The nine key elements and where they are addressed in this update of the Plan are found in **Appendix H**. One key element requires the NPS program to contain explicit short (up to five years) and long-term goals, objectives and strategies to protect surface and ground water and to review, evaluate and update the program every five years. This update meets that element.

The *Montana Nonpoint Source Management Plan* is divided into six sections following this introduction. **Section 2** of the document provides background information on Montana's water resources and describes the types and causes of NPS pollution addressed by this plan. **Section 3** describes Montana's overall framework for addressing water pollution problems on a statewide basis. **Section 4** describes the State's NPS pollution goals and objectives and discusses the actual components of the statewide NPS management strategy. **Section 5** of the report describes Montana DEQ's five-year NPS priorities and action plan, and **Section 6** describes the Department's self evaluation plan for periodically evaluating the effectiveness of the NPS strategy. Lastly, **Section 7** describes how to find additional information resources pertaining to NPS pollution. A number of appendices at the end of the document provide additional details on NPS control activities and other subject matter.

SECTION 2.0 MONTANA WATER RESOURCES ASSESSMENT

This section of the Plan provides a brief description of Montana's water resources and water uses, and discusses the causes of water quality impairment in streams, lakes, wetlands, riparian areas, and ground water with an emphasis on nonpoint sources of pollution addressed by this Plan.

Montana's water resources are in many ways the lifeblood of the Treasure State. Waters of adequate quantity and quality are necessary to sustain the state's economies as well as to meet basic biological needs. It is crucial that NPS pollution, Montana's most pervasive water quality problem, be managed effectively so that all current and future beneficial uses of the state's waters are supported.

At 145,552 square miles (93 million acres), Montana is the fourth largest state in the nation but ranks 44th in human population. If the state's 935,670 residents were spread evenly across the land, there would only be 6.4 persons per square mile (U.S. Census Bureau, 2007). Of course, people are not distributed uniformly. Populations, and population growth, are concentrated in the valleys of the western and southwestern portion of the state. During the 1990s, Montana's population increased by 12.9 percent. Nearly 60 percent of Montana's residents live in just seven of the 56 counties, and 36 percent of residents live in just eight cities. Six of the eight largest cities and six of the seven most populous counties are located in western Montana where recent growth has ranked among the top national rates. However, the majority of the state's land area has a very low population density. Rapid urban and suburban growth in localized areas of the state represents perhaps the greatest challenge for managing NPS pollution.

The availability of high quality water has been a defining factor in the settlement of the state, with most of the population concentrated along major river valleys. This places a large percentage of the state's population and many potential contaminants in close proximity to water resources that are valued for drinking water supply, irrigation, industry, recreation, and aquatic habitat. This is a precarious situation that underscores the need to be proactive in protecting Montana's water resources from NPS pollution.

Almost a third of Montana's 93 million acres is managed by the federal and state government: 17 million acres are managed by the United States Forest Service (USFS), mostly in the western half of the state; 8 million acres are administered by the Bureau of Land Management (BLM); and lesser acreage is controlled by the National Park Service and other agencies (http://nris.mt.gov/gis/requests/county_own.html). The State of Montana owns more than six million acres of land, most of it managed by the Montana Department of Natural Resources and Conservation (DNRC). There are seven Indian reservations in the state with Indian trust, tribal, and allotted lands in the state totaling approximately 4 million acres (Ibid). Agriculture, recreation and tourism, forest products, and mining have formed the traditional base of Montana's economy. The eastern third of Montana is prairie land and a part of the Northern Great Plains ecosystem. The middle third of the state is prairie surrounding island mountain ranges. Western Montana is characterized by rugged mountain ranges and deep river valleys. Generally speaking, precipitation decreases from west to east and varies from 80 inches in the high western mountains to less than 10 inches in the northeastern plains.

2.1 Water Resources Inventory

Montana has approximately 49,643 miles of perennial streams, 117,065 miles of intermittent streams, and 7,094 miles of ditches and canals. The total size estimate for lakes, reservoirs and wetlands is 691,826 acres (**Table 2-1**) (DEQ 2006).

Table 2-1: Montana's Surface Water Resources.

RIVER BASINS	Perennial Streams (Miles)	Intermittent & Ephemeral Streams (Miles)	Ditches & Canals (Miles)	Lakes, Reservoirs & Wetlands* (Acres)
Columbia	16,997	12,522	1,022	226,986
Upper Missouri	14,603	17,858	2,504	101,613
Lower Missouri	8,872	47,713	1,637	344,163
Yellowstone	9,171	38,972	1,951	22,064
Montana Total	**49,643**	**117,065**	**7,094**	**691,826**
* Named waters at least 5 acres in area. Size estimates of all waters derived by DEQ staff from 1:100,000 scale National Hydrography Dataset (NHD).				

Montana ranks third in the conterminous United States in the number of stream miles, sixth in the number of lakes and eighth in total lake acreage (Montana Watercourse 1996). Montana has been called the "Headwaters of the Continent." It is the only state that sends water to three oceans. A few of Montana's most unique water resources include the Yellowstone River, the longest free flowing river in the lower 48 states; Flathead Lake, the largest natural freshwater lake in the U.S. west of the Mississippi River; the highly productive Missoula Valley Aquifer, a designated sole source aquifer; and the Prairie Pothole wetlands of the Northern Great Plains.

The state is comprised of three major and two minor river basins (Montana Watercourse 1996) (**Figure 2-1**):

- Two tributaries of the Columbia, the Clark Fork and the Kootenai, drain 26 million acre-feet of surface water from a land area totaling 25,125 square miles. This drainage area represents only 17 percent of the state's land area but accounts for 53 percent of the annual surface flow.
- Conversely, the Missouri River and its tributaries drain 56 percent of the state, over 82,000 square miles, yet only contribute 17 percent of the annual surface flow (8 million acre-feet).
- The Yellowstone River drains 36,000 square miles (24 % of the state) and carries 9.5 million acre-feet (21%) at its confluence with the Missouri River near the Montana-North Dakota border.
- The Little Missouri River in the southeast corner of the state drains just two percent of the land area in Montana.
- The St. Mary's River flows north toward the Arctic Ocean from Glacier National Park, draining two percent of the water from one percent of Montana's land area.

These five river basins are divided into 16 major sub-basins which are further divided into about 90 watershed planning areas. Many of the state's water pollution control programs have adopted a watershed approach for managing streams and lakes, so that the entire drainage area is assessed for potential impacts to water quality. The Water Quality Planning Bureau (WQPB) at the Department of Environmental Quality uses the watershed approach to guide water quality planning, protection, and restoration activities. Managing water resources from a watershed perspective presents challenges as few administrative boundaries fall entirely within a watershed. This underscores the need for collaboration among the various public and private entities within a watershed to protect and restore water resources, particularly in the case of NPS pollution.

The State of Montana's water quality management program has authority for managing about 82 percent of the state's total stream miles and about 92 percent of the lake, reservoir and wetland acres shown in **Table 2-1**. U.S. Environmental Protection Agency (EPA) is responsible for developing TMDLs and associated restoration plans for all waters located entirely within Indian Reservations. In addition, waters that are within National Parks and Wilderness Areas are not subject to state management activities. However, with the exception of waters on Tribal lands, the Montana water quality management program takes a direct interest in the quality of all waters in the state.

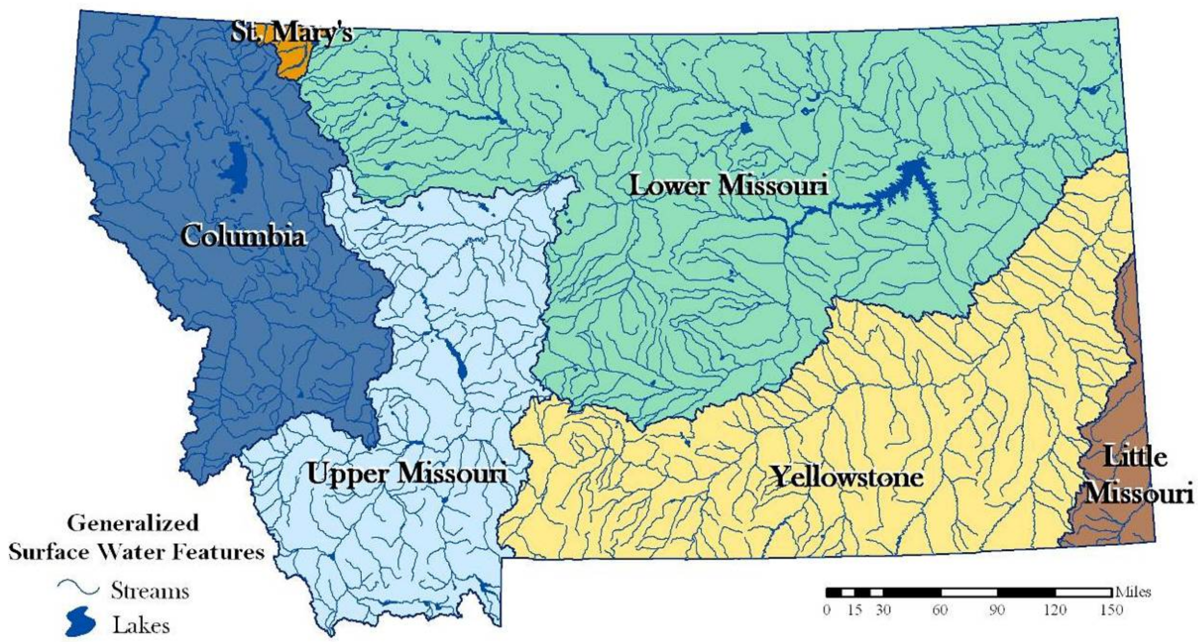


Figure 2-1: Montana's Major and Minor River Basins (NRIS 2006)

2.1.1 Streams and Lakes

Streams and lakes are prominent features on Montana's landscape, and are perhaps components of the water cycle with which we are most familiar. It naturally follows that these resources are prone to NPS pollution. Streams in the state range from large rivers that flow year round (perennial), to ones that only flow when recharged by ground water or precipitation (intermittent), to drainages that sporadically carry flow during runoff events (ephemeral). Most of the stream miles in Montana are small ephemeral or intermittent streams, although perennial streams are more often emphasized. Lakes in the state range from natural freshwater systems, to reservoirs, to saline basins that may evaporate during the course of a year. Many freshwater lakes are found in areas of the state that experienced glaciation during the last ice age. Numerous man-made reservoirs and impoundments are scattered throughout the state and are often regulated by the Montana DNRC for water rights and other authorities (e.g. hydroelectric generation and federal ownership). Saline basins are commonly located in prairies east of the Continental Divide, and may be influenced by Cretaceous marine shale geology.

In Montana, approximately 8.1 billion gallons per day of surface water are used for residential and commercial purposes, including public water systems, household domestic water, irrigation, livestock, industry, and mining (United States Geological Survey (USGS 2000). Irrigation accounts for 97 percent of this supply, making it, by far, the primary user of the state's surface waters (USGS 2000). Most of the state's surface water supply is already legally allocated, or is in the process of being allocated by the DNRC and the Montana Water Court. There are basins in the state where surface water rights have been over-allocated; meaning that streams or lakes can be legally dewatered and junior water rights may not be met. The demand for high quality water is expected to increase in the future as the state's population and industries continue to grow. In practical terms, this means the use of ground-water resources must increase, but caution is necessary because shallow ground-water and surface-water systems are often connected. Expanding the use of ground water in an area where surface water is already in short supply may only make existing problems worse.

Montana DEQ's water resources assessment information includes 66 lakes covering 606,291 surface acres. Lakes are among Montana's most valued and most threatened water resources due in large part to their capacity to trap, hold and concentrate pollutants. DEQ has a lake and reservoir monitoring project, with main objectives being to refine water quality standards for lakes, develop a lake and reservoir classification system, assess beneficial use attainment of lakes, and provide data for analysis of trends and monitor the effectiveness of restoration efforts. Montana has specific regulations for lakes which were enacted to protect lake shorelines, water quality, and habitat for fish and wildlife (Montana Code Annotated 75-7-201 – 217). This regulation allows local governments to regulate construction and development activities along lake shorelines through permits.

2.1.2 Wetlands and Riparian Areas

Wetlands and riparian areas play a significant role in protecting water quality and reducing or eliminating the adverse impacts of NPS pollution by providing natural buffers between uplands and adjacent water bodies. Besides improving water quality, wetlands and riparian areas provide stream shading, floodwater attenuation, shoreline stabilization and erosion control, ground-water recharge, and habitat for a variety of aquatic, semi-aquatic, terrestrial, migratory, and rare species. Loss of these systems allows for a more direct contribution of NPS pollutants to receiving waters. These numerous and diverse benefits of wetlands and riparian areas make their protection essential.

Defining wetlands is challenging, especially in the west. They are generally thought to represent a transition between aquatic and upland habitats but are difficult to define because the distinction between wet and dry environments lies along a continuum (**Figure 2-2**). Wetlands generally include swamps, marshes, bogs, and similar areas. Jurisdiction wetlands are defined as those areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Jurisdictional wetlands are afforded protection under the CWA, and perform a range of functions (e.g. hydrologic, flood control, and aquatic habitat functions) in addition to pollutant removal. Ecological or functional wetlands perform the same range of functions and pollution control yet only need to meet one of the three criteria of jurisdictional wetlands: hydric soil, hydrophytic plants or wetland hydrology.

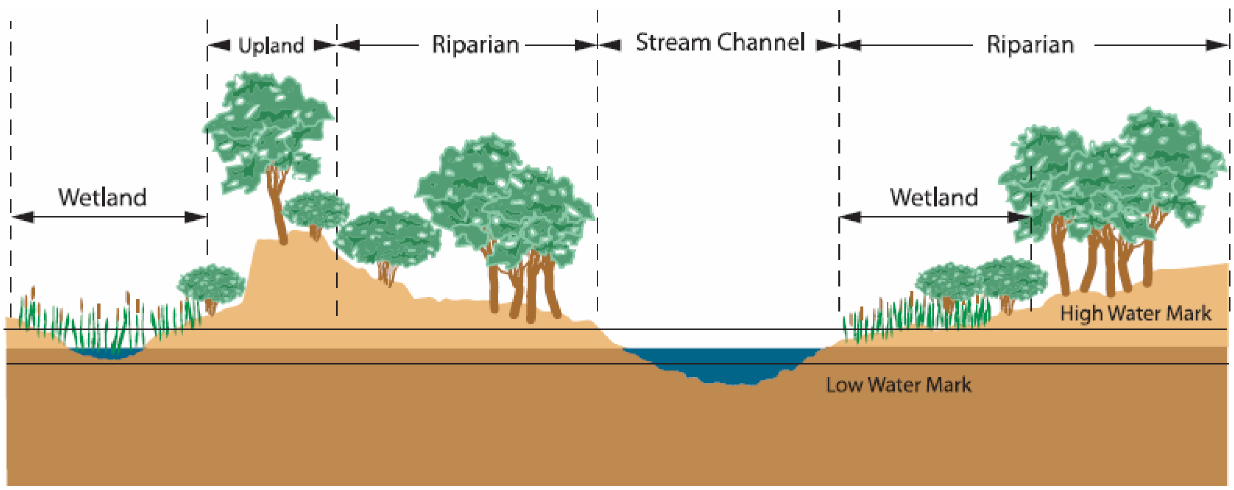


Figure 2-2: Relationship between Wetlands, Uplands, Riparian Areas and the Stream Channel

Riparian areas are vegetated areas along a water body through which energy, materials, and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding and influence from the adjacent water body. These systems encompass wetlands, uplands, or some combination of these two landforms. Riparian areas do not always have all the characteristics necessary for them to be classified as wetlands but they generally perform the same functions (pollutant filtration, shoreline stabilization, wildlife habitat, etc.)

Monitoring and assessment of wetlands throughout Montana indicates that wetlands are far more diverse than anticipated. Water chemistry in Montana’s wetlands varies from water with very low dissolved solids, similar to high mountain streams and lakes, to marine quality levels of salinity. The amount of water associated with wetlands is equally varied. Some wetlands have large open-water areas, while others are simply wet meadows. On a broad scale, wetlands can be divided into three categories: little or no open water, open water is prevalent, and riverine. Water chemistry, vegetation, connection to ground water, presence of an inlet, outlet, or both, and persistence of wetness can vary widely within each category. At this time, accurate maps do not exist for Montana's wetlands as they do for streams and lakes. As a result, only estimates of their aerial extent are available. Draining, dredging, and filling activities that have occurred since

European settlement began have destroyed about 30 percent of the original wetland acreage in Montana (Dahl 1990).

Since 2001, EPA has provided funding for development of a comprehensive Montana wetland monitoring and assessment program and assessment tools to allow managers to better evaluate wetland restoration and protection needs on a statewide basis. Funding was originally used to develop vegetation and amphibian biological assessment tools and a geographic information system (GIS) landscape assessment tool (Daumiller 2004). The development of bird biological criteria for wetlands was added in 2003 (Noson et al. 2005). Wetland rapid assessment survey methods were developed in 2004 and a rapid assessment database was constructed in 2005 (DEQ 2005d). Development of these assessment tools has drawn primarily from research in the Red Rocks region in southwest Montana.

EPA has recently provided funding for wetland demonstration pilot projects which utilize landscape assessment tools to help track wetland gains and losses, and contribute to the state's wetland assessment experience and resources for the future (DEQ 2005c). Montana DEQ's wetlands program intends to initiate demonstration pilot projects within the Gallatin, Flathead and Bitterroot valleys where wetlands are considered to be most at risk due to recent development pressures and changing land uses. This three-year effort includes developing a database to track wetland gains and losses, digitizing mid-1980's National Wetland Inventory maps as a baseline, and conducting wetland imagery analysis using 2005 color infrared digital orthophotography to delineate and map current wetland-riparian areas. Field surveys will supplement remote analysis and trends in wetland acres, types and disturbance will be determined (MNHP 2006).

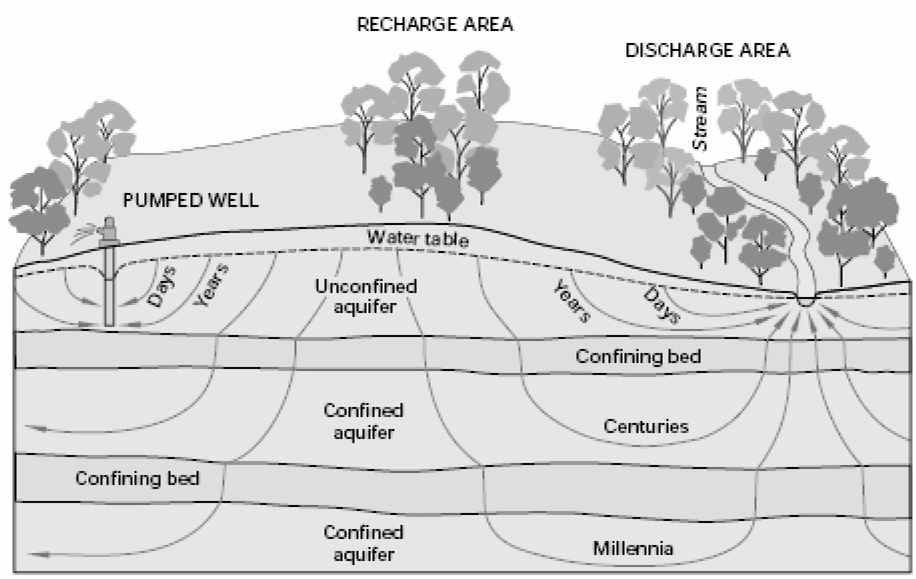
2.1.3 Ground Water

Ground water is a valuable resource in Montana that is vulnerable to the effects of NPS pollution. Depending on the setting, ground water can be intricately linked with surface water. Alternately, ground water may be the primary water supply in areas where surface water is scarce. Increased awareness of the connection between ground water and surface water at the national and state levels has led to a drive to manage these waters as one resource. Measures taken to safeguard surface waters will ultimately benefit ground-water supplies and vice versa. However, the concealed nature of ground water presents unique challenges for the protection of this resource.

The ground-water component of the water cycle involves the storage and movement of water within gaps, pores, or other voids below the earth's surface. Water infiltrates into the ground under the influence of gravity. The level at which subsurface materials become saturated is termed the ground-water table. Gains to ground water are referred to as recharge, while losses are termed ground-water discharge. In general, ground water flows from recharge areas to discharge areas. Ground-water recharge and discharge are influenced by natural (i.e. precipitation and surface water interactions) as well as artificial processes (i.e. land development, well use, and irrigation).

Ground water that accumulates within sediments or rock formations is termed an aquifer when there are sufficient quantities and water bearing properties to be used as a water supply. Aquifers can be confined or unconfined, which refers to whether ground water completely fills the aquifer and is under pressure below less permeable geologic units (confined) or ground water only partly fills the aquifer and the water table is free to rise and decline (unconfined). Like surface water, ground water is constantly in motion, but the rate of movement is generally much slower than that observed in streams (**Figure 2-3).** The slow rates of ground-water movement, in comparison to surface water, have implications for ground-water supplies and ground-water quality.

Ground-water systems are usually hydraulically connected to surface water systems. The degree of this connection varies. Shallow unconfined aquifers often have a high degree of interaction with streams that flow on top of the aquifer, hence the aquifer and the streams have water flowing between them. Deeper aquifers typically have a lesser degree of interaction with the surface water system. During the fall and winter months when streams receive minimal runoff from snowmelt and rain, ground-water discharge to streams is the primary source of water for streamflow. This component of streamflow is called baseflow.



(Used with permission from *Ground Water and Surface Water*, a Single Resource: Winter et al 1998)
Figure 2-3: Conceptual Diagram of Ground-Water Storage and Movement

The Montana Ground Water Information Center (GWIC) at the Montana Bureau of Mines and Geology (MBMG) maintains records for more than 198,000 wells. Since 1975, Montanans have constructed 84,500 wells claiming domestic use, 13,100 wells claiming stock water use, 6,500 wells claiming irrigation use, and about 1,350 public water supply (PWS) wells. Approximately 188 million gallons per day of ground water are used for residential and commercial purposes (USGS 2000). Irrigation and public water supplies are the major uses of Montana’s ground water, at 44 percent and 30 percent, respectively (USGS 2000). Although ground-water supplies make up a smaller portion of the state’s water use in comparison to surface waters, it is important to note that ground-water supplies are the primary source of drinking water for rural domestic water supply as well as public water systems (greater than 90% for both categories).

For the most part, ground-water supplies in the state are developed in shallow, unconfined or partially-confined alluvial aquifers that were formed by streams and glaciers (**Figure 2-4**). The somewhat limited extent of alluvial aquifers east of the Continental Divide has led to ground-water development in deep aquifers in this part of the state. Poor water yields and water quality oftentimes limits the number of applications for use of these deep aquifers. As discussed previously, the use of ground-water resources in the state must increase to meet new demands where surface water resources are already allocated for existing uses. The state, through the MBMG, has initiated a systematic study of ground-water resources by passing the Montana Ground Water Assessment Act in 1991. This task is ongoing and will produce much needed information to address important issues, such as the viability of expanding ground water use in the state and identifying where ground-water resources are vulnerable to contamination. Although the state is taking important steps towards better defining ground-water resources through the work of the MBMG, there is currently no overall coordination of ground-water stewardship and protection activities within Montana. Potentially compounding this issue is the fact that while watershed areas are generally easy to define for surface water bodies, an aquifer's boundary can only be inferred from field data observations and may expand across several watershed boundaries.

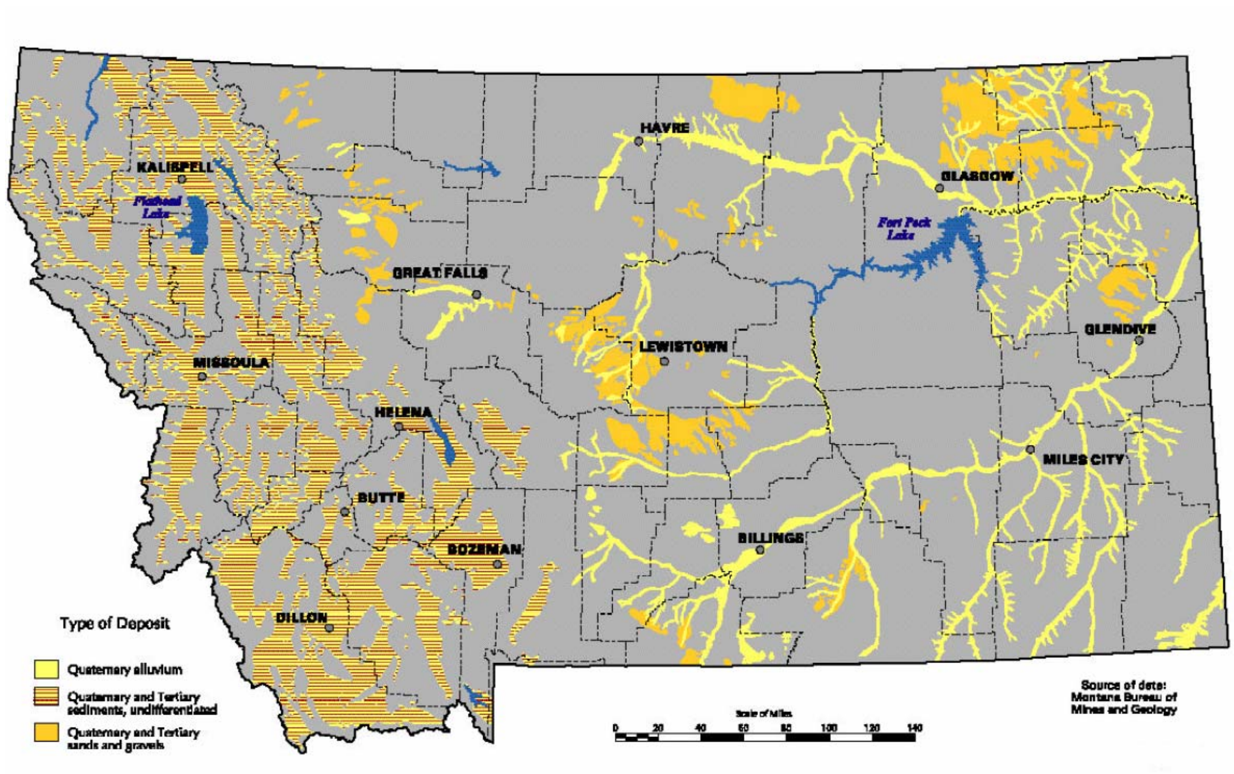


Figure 2-4: Montana's Major Alluvial Aquifers (NRIS 1998)

The lack of a coordinated ground-water protection strategy in Montana is a concern because of the dependence on ground water for drinking water supplies, because contaminated ground water is very difficult and expensive to clean up, and because WQPs have been developed for surface waters that may be intricately linked to ground water. Refer to **Appendix B** for a more in depth review of the ground-water protection programs in place in Montana.

In some areas, ground water in the state has become contaminated by some of the same causes and sources as surface waters. For instance nitrates, bacteria, solvents, benzene, cyanide, pesticides, and salts in ground water have been linked to septic systems, industrial wastewater disposal, leaking underground storage tanks, mining, and certain agricultural practices. A 2006 query of Montana's Safe Drinking Water Information System database for public water supplies confirms that wastewater treatment systems, transportation, industry, and agriculture are the primary sources threatening to contaminate highly susceptible public water supplies (**Figure 2-5**).

Concern about the rate and scale of ground-water quality impacts is increasing in the state, for the most part due to the rising use of wells for drinking water and individual septic systems for on-site waste disposal. Septic systems and other domestic on-site wastewater treatment systems are of particular concern in the rapidly developing areas of the state because there are no specific programs in place to regulate the maintenance and operation of private individual septic systems. A recent study in the Helena Valley detected pharmaceutical compounds in 80 percent of the wells that were sampled and concluded that domestic wastewater is likely degrading ground-water quality there (Miller and Meek 2006).

Suburban growth and development are replacing traditional land uses in many areas of the state. However, irrigated agriculture is a traditional land use which has been thought, and in some instances proven, to degrade ground-water quality by leaching excess fertilizers through the soil. In addition to ground-water quality impacts associated with irrigation practices, dry land farming has been linked to shallow ground-water contamination from saline seep and elevated levels of soil organic nitrogen. Ground-water contamination from mining and industrial activities has also occurred in the state. The DNRC has closed seven areas of the state for ground water use permits due to the potential health risks from ground water polluted by past mining and industrial activities. Addressing water quality impacts from NPS pollution will be beneficial for both ground-water and surface-water resources.

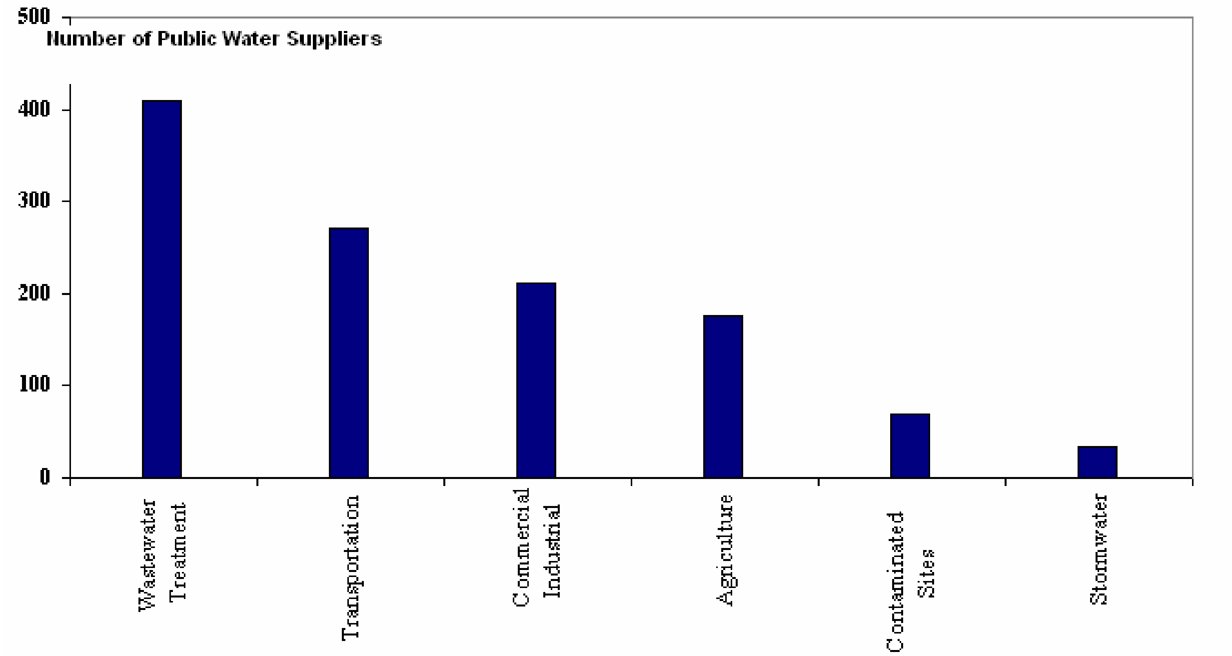


Figure 2-5: Montana's Highly Susceptible Public Water Supply Systems Ranked by Potential Ground-Water Contaminants (EPA http://www.epa.gov/safewater/sdwisfed/sdwis.htm)

2.2 Nonpoint Source Problems and Causes

Sections 305(b) and 303(d) of the federal CWA require states to monitor, assess, and report on the condition of their surface water resources every two years. Montana has been preparing these biennial reports since 1992. The Montana 305(b) report provides a comprehensive statewide water quality assessment for the state's streams, lakes, wetlands, and ground water and an inventory of the severity of NPS problems and their causes. The Montana 303(d) list is derived from the statewide assessment and identifies surface waters that fail to meet state water quality standards, or which are threatened. The Montana 2006 Integrated Report represents Montana's most current 305(b) and 303(d) assessment information.

The 2006 Integrated Water Quality Report concluded that NPS pollution is the leading cause of surface water impairments in Montana, accounting for approximately 90 percent of the problems in streams and 70 percent of the lake problems. Thus, the primary water quality management challenge in the years ahead will be to protect and restore water quality through the focused management of NPS pollution.

According to the 2006 Integrated Report, sediment, nutrients, heavy metals, and water temperature problems are responsible for the greatest number of impaired stream miles in Montana relative to other causes of water quality impairment. The pollutants affecting the greatest number of lake and reservoir acres were metals (particularly mercury and lead), sediment, polychlorinated biphenyls (PCBs), and nutrients (**Table 2-2**). These pollutants are generated by the same land uses that have traditionally driven the state's economy, including farming, grazing, logging, mining, roads, urban and suburban development, and many other activities. The 2006 Integrated Report further concluded that agriculture, including dry land farming, irrigated crop production and grazing, hydromodification (actions that change natural flow patterns including channel straightening, channel relocation, and dams), habitat modification, atmospheric deposition, and resource extraction (mining) are among the leading nonpoint sources of stream and lake water quality impairments (**Figures 2-6 and 2-7**[1]).

Table 2-2: Leading Causes of Water Quality Impairment Identified in the 2006 Montana Integrated Report*

Rank	Rivers and Streams	Lakes
1	Sediment	Metals
2	Nutrients	Nutrients
3	Metals	Sediment
4	Water Temperature	PCBs

* Based on total assessed miles of impaired stream and lake acres.

[1] Due to the size and diversity of the State of Montana, DEQ uses a preliminary screening approach to assess the waters of the state for purposes of Clean Water Act Section 303(d). Waters that do not meet water quality standards are reported as "impaired" on the State's 303(d) list. The probable causes (i.e., which pollutant) of the impairment and probable sources (e.g., agriculture, municipal waste water treatment discharge, etc.) are also reported in the 303(d) list. The relative importance of the various non-point source reported in **Figures 2-6 and 2-7** of this document are based on the screening level information reported in Montana's 2006 IR. This information is intended only to provide a general, preliminary assessment of the relative importance of the various non-point sources of pollutants at the statewide scale.

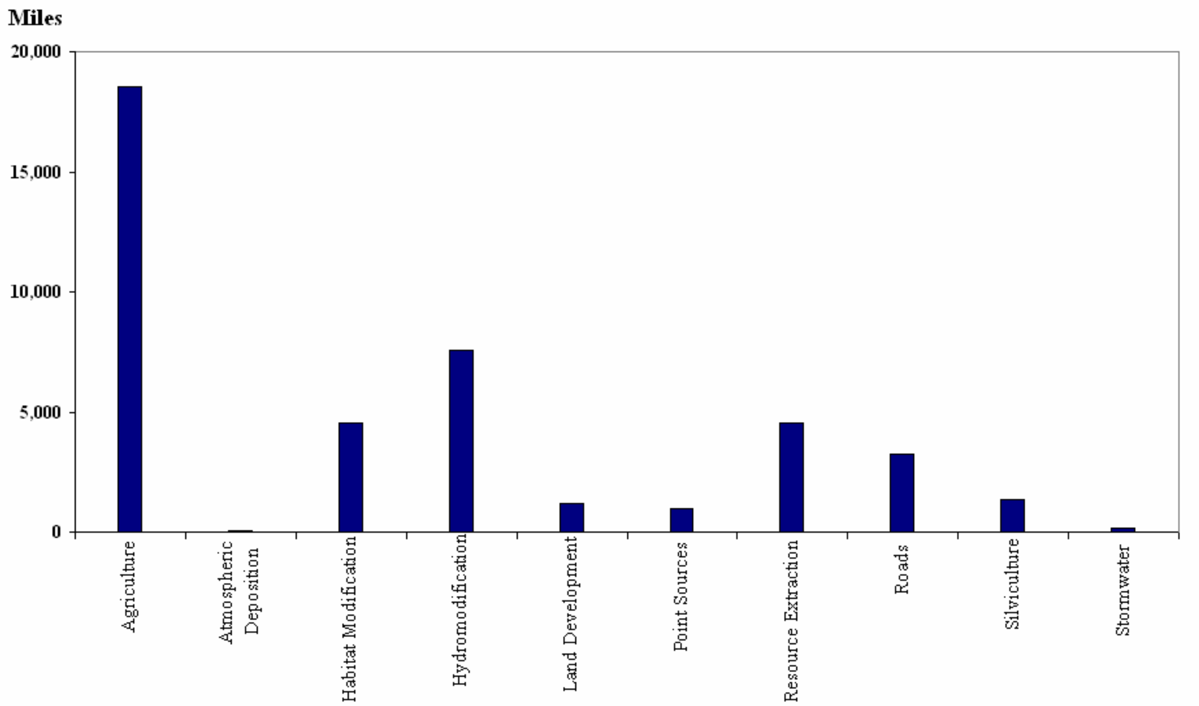


Figure 2-6: Montana Impaired Stream Miles* Listed by Major Pollution Source Categories (DEQ 2006)
* Based on total assessed miles of impaired streams

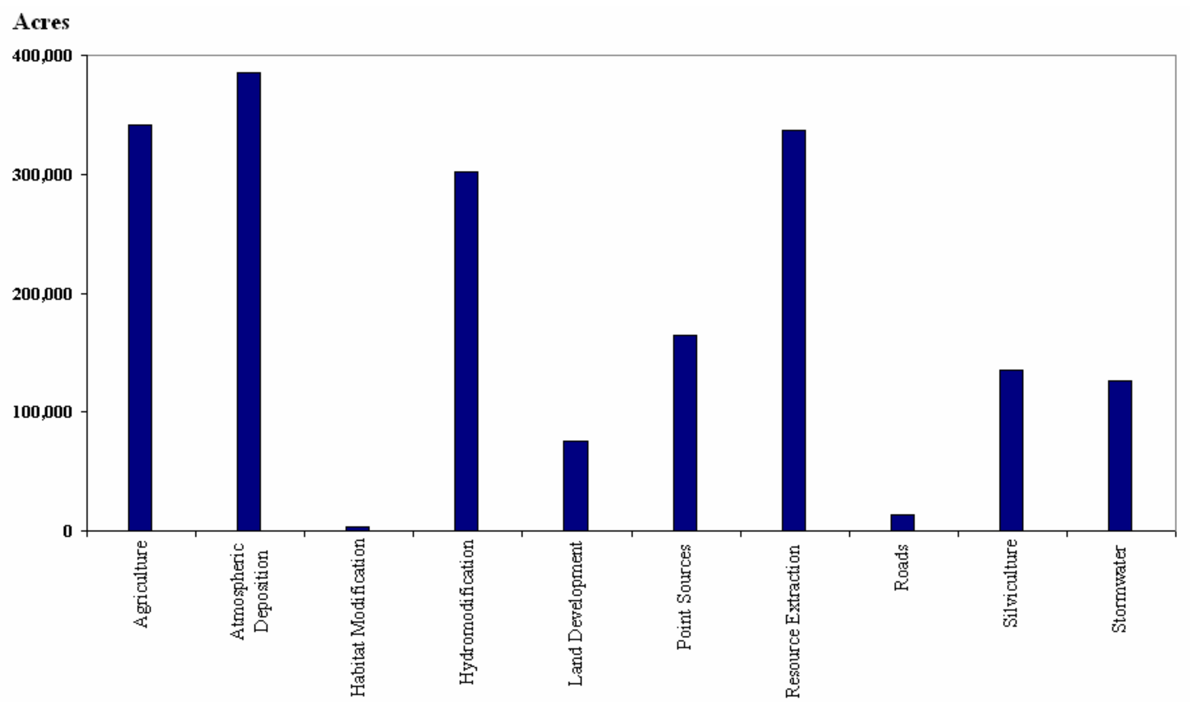


Figure 2-7: Acres* of Impaired Lakes, Reservoirs and Wetlands in Montana Listed by Major Pollution Source Categories (DEQ 2006)
*Stream miles and water body acreages were tallied for each impairment source category and may be represented more than once. Based on total assessed miles of impaired stream and lake acres.

The primary nonpoint sources of pollution within the State of Montana are described below. The state's strategy for mitigating these problems is described in detail in **Section 4** of this plan.

2.2.1 Agriculture

Montana farms and ranches cover 64 percent of the state—nearly 59.6 million acres. Thirty percent of this is cropland and sixty-five percent is range and pasture land. Agriculture is Montana's leading industry, and generated $2.7 billion in 2004; $ 1.1 billion in crops and $1.2 billion in livestock (http://www.nass.usda.gov). Wheat is by far the leading cash crop, much of it grown in a dry land crop-fallow rotation to conserve moisture. The bulk of the farmland is east of the Rocky Mountains, although there are many important agricultural areas in western Montana.

Agricultural pollution may result from range and cropland erosion, farming practices, streambank destabilization, livestock manure, and chemical applications of fertilizers and pesticides. Pollutants include: sediment, bacteria, nutrients, pesticides, salinity, selenium, and thermal modification from changes in the hydrology and riparian and aquatic habitats.

2.2.2 Forestry

As with farms and ranches, forests cover a large portion of Montana. Nearly a quarter of Montana's land area is forestland (22.5 million acres). In 2004, the forest products industry contributed $970 million to the state's economy. The forestlands of Montana are also the headwaters for many rivers and streams. These provide some the West's best fishing as well as water for agriculture, recreation, drinking water, and many other uses. Forestry activities, however, can lead to impairment of beneficial uses, such as aquatic life, because of increases or changes in sediment, nutrients, temperature, or habitat conditions. Activities such as road building, soil disturbance, and harvest unit management may generate pollutants or cause deleterious changes to water quality or aquatic or riparian habitats.

Similar to agricultural practices that can impact the natural hydrograph, logging can cause increases in forest runoff, stream bank erosion, and channel destabilization.

2.2.3 Diffuse Urban and Suburban Pollution

NPS pollution from urban and suburban sources encompasses a broad range of activities associated with domestic, municipal, industrial and commercial land development and land uses. Diffuse pollution can be generated during the construction, operation and maintenance or lack thereof, of buildings (e.g. homes, businesses, plants/factories) and infrastructure (e.g. roads, sidewalks, landfills, septic systems). Landfills, particularly unlined facilities, pose a threat to surface and ground-water quality because harmful and toxic substances may leach into aquifers or surface waters.

Pollution from urban, suburban and industrial areas and transportation networks is a significant source of pollutants such as sediment, nutrients, oil and grease, pesticides and fertilizers, bacteria, and metals (e.g. lead, copper, and zinc). Mitigation of diffuse urban and suburban pollution sources presents many challenges. The cumulative impacts to water quality may be substantial in watersheds with extensive development.

Storm Water Runoff

In Montana, pollution from storm water runoff is somewhat localized due to the relatively low population density but water quality effects can be significant. Point source discharge permits for municipal storm sewer systems are currently required for seven urbanized areas and cities in Montana: Billings, Bozeman, Butte, Great Falls, Helena, Kalispell, and Missoula. Additionally, portions of Cascade, Yellowstone and Missoula Counties, the University of Montana, Montana State University (MSU), Malmstrom Air Force Base, and the Montana Department of Transportation (MDT), also require MPDES discharge permits.

Construction

Construction activities by their very nature disturb soils and create opportunities for erosion that can in turn increase sediment and nutrient loads to surface waters. Additionally, habitat alteration from construction activities (e.g. alteration or removal of riparian vegetation) can have significant negative impacts upon aquatic systems and stream bank and shoreline stability. Construction projects over one acre in size are typically required to obtain MPDES discharge permits.

Waste Disposal

Approximately 302,000 Montanans contribute waste to an estimated 121,000 individual household sewage disposal systems, also called septic systems or onsite subsurface wastewater treatment systems. A well-constructed and maintained septic system in suitable soils treats many household wastes. However, poorly designed, improperly sited, or neglected systems may be sources of excess nutrients (especially nitrate), pathogens and household chemicals. In some areas, septic systems are a significant water quality concern. There has been little coordinated planning, zoning or infrastructure investment in most of the semi-rural and suburban areas near Montana’s major cities and recreation areas such as lakes and ski resorts.

If wastes aren’t placed ‘down the drain’, they usually end up in a landfill. Some exceptions to this are solid wastes that can be biologically treated, such as sludge pumped from septic tanks and waste water treatment facilities (i.e. biosolids), and petroleum contaminated soils. Land application of wastes is monitored by the DEQ’s Solid Waste Management Program for water quality impacts.

Landfills are located in every large municipal area and every county, and may be a source of sediment and hazardous constituents. Unlined landfills are a concern because contaminants are likely to mix with ground water. Thirty years ago there were more than 500 landfills and waste dumps in Montana. Most of these have been closed. By 2007 there were 108 licensed solid waste facilities. Twenty-seven active and thirteen inactive waste management facilities are monitored for ground-water quality impacts.

Roads

The transportation system within the state contributes to nonpoint source pollution through runoff, atmospheric deposition of nitrogen oxides, flood plain and river channel encroachment, and construction and maintenance activities. Road maintenance activities like roadside vegetation management and winter maintenance can contribute chemicals (pesticides and deicing solution) and sediment to adjacent waterways. Sediment, nutrients, dissolved solids, metals, oil and grease, and habitat loss and degradation are all potential causes of nonpoint source pollution related to transportation. Paved roads may be more likely to have chemical effects on water quality due to a greater propensity for use and thus higher chances of accidental spills. Paved roads may also be more likely to transport storm water runoff due to the impervious nature of asphalt. Gravel and dirt roads may cause excessive sediment deposition. Road structures, such as undersized culverts, can also be problematic for water quality.

2.2.4 Resource Extraction and Contaminated Sediment

Working mines are regulated with federal and state permits including point source discharge permits. In order to obtain a permit, mine operators have to post a bond covering liability for cleanup and restoration. However, abandoned and inactive mines are significant sources of NPS pollution in many of Montana’s watersheds. DEQ’s Mine Waste Cleanup Bureau (MWCB) has designated 300 Priority Mine Sites. The MWCB’s activities focus on two primary site types: 1) inactive mine sites addressed under the Surface Mining Coal and Reclamation Act and 2) mining-related sites addressed under the federal Comprehensive Environmental Responsibility, Compensation, and Liability Act (CERCLA) (Superfund sites). NPS impacts associated with resource extraction include excessive metals and/or sediment, which can harm aquatic life and impair drinking water use. Montana has addressed many long-abandoned mine and mill sites; to date 283 projects have been completed.

Much of eastern Montana lies atop coal beds that are potential reservoirs of methane gas. Coal bed methane (CBM) extraction may impact water quality in several ways. These include increased flows from surface water discharges of ground water, and changes in water chemistry including salinity, sodium adsorption ratio (SAR), and total suspended solids (TSS). Salinity is a particular concern to farmers and ranchers, as too much salt in irrigation water can inhibit plant growth, destroy soil productivity, and even limit its use as stock water.

Metals and long-lived organic pollutants from past mining-related activities, fuel spills, rail yards, wood treatment plants, and other industrial sources often accumulate in streambeds and lake sediments. These pollutants may be directly toxic to aquatic life and humans, or they may be concentrated in tissues of fish and higher animals that feed on fish or aquatic life. Through bioaccumulation, concentrations of these pollutants can reach levels that are harmful to the health of wildlife and humans.

2.2.5 Hydrologic Modification

Hydrologic modification includes changes in stream flow, channel straightening, widening, deepening, clearing, or relocating existing stream channels. Flow modification affects water temperature, sediment transport, dissolved oxygen (DO), instream flows, and stream bank stability. Temperature and flow changes may limit aquatic life and recreational uses downstream. Sources of flow modification include dams, weirs for irrigation and stock watering, undersized culverts, transportation embankments (rip rap), and off-channel constructed “water features” such as fishing ponds.

2.2.6 Recreation

Most Montana residents engage in outdoor recreational activities of which more than half is water-based (Montana SCORP, 2003). Water-based recreation includes activities on lakes and rivers, along the shores of rivers, streams, and lakes, and in riparian areas. Intensive or inappropriate recreational activities can harm water quality and, in turn, poor water quality can degrade recreational activities and impair other beneficial uses.

NPS impacts associated with water based recreation and other forms of recreation include sedimentation of streams, shoreline erosion, habitat alterations, spread of noxious and invasive species, nutrient enrichment, water contamination from sewage, pathogens, petroleum products, thermal pollution, and other toxic substances.

2.2.7 Atmospheric Pollution

The 2006 Montana Integrated Report (DEQ 2006) identifies atmospheric deposition as a probable source of impairment for three large lakes and reservoirs in Montana: Flathead Lake, Fort Peck Reservoir, and Holter Lake. These lakes total over 376,500 surface acres. Pollutants attributed to atmospheric deposition include nitrogen, phosphorus, mercury, and chemicals such as PCBs. Atmospheric deposition is a source that does not fit well in the watershed approach since sources are most likely removed from the affected water body. It is a state, regional, national, and international challenge that will require significant coordination beyond Montana DEQ to resolve.

SECTION 3.0 MONTANA'S NONPOINT SOURCE POLLUTION MANAGEMENT PROGRAM FRAMEWORK

This section of the *Montana Nonpoint Source Management Plan* describes the organizational framework and programmatic elements of Montana's NPS management program. **Section 4** of the Plan describes the actual NPS pollution control strategy and its various elements in greater detail.

Authority for controlling NPS pollution on a national level is provided in the federal Clean Water Act. The original CWA, passed in 1972, established a national framework for protecting and improving water quality. The overall goal of the CWA is "to restore and maintain the chemical, physical and biological integrity of the Nation's waters." Specific objectives include the elimination of discharges of pollutants and attainment of interim water quality levels that will protect fish, shellfish and wildlife, while providing for recreation in and on the water wherever possible.

3.1 Montana's Water Quality Management Process

Protection and management of Montana's water resources is accomplished through a series of component parts. Each of these components is described in the following sections in relation to the state's management of nonpoint sources. A schematic of DEQ's water quality management planning process is shown in **Figure 3-1**. Montana's water quality programs operate in an integrated fashion to ensure success at the program level and to achieve overall water quality protection and restoration goals. The NPS program relies on the successes of other water quality programs, such as the monitoring, standards, and TMDL programs, in order to achieve its own successes. Therefore, the NPS program dedicates some of its resources to other water quality programs so that the NPS program has the tools it needs to achieve restoration of impaired water bodies and watersheds.

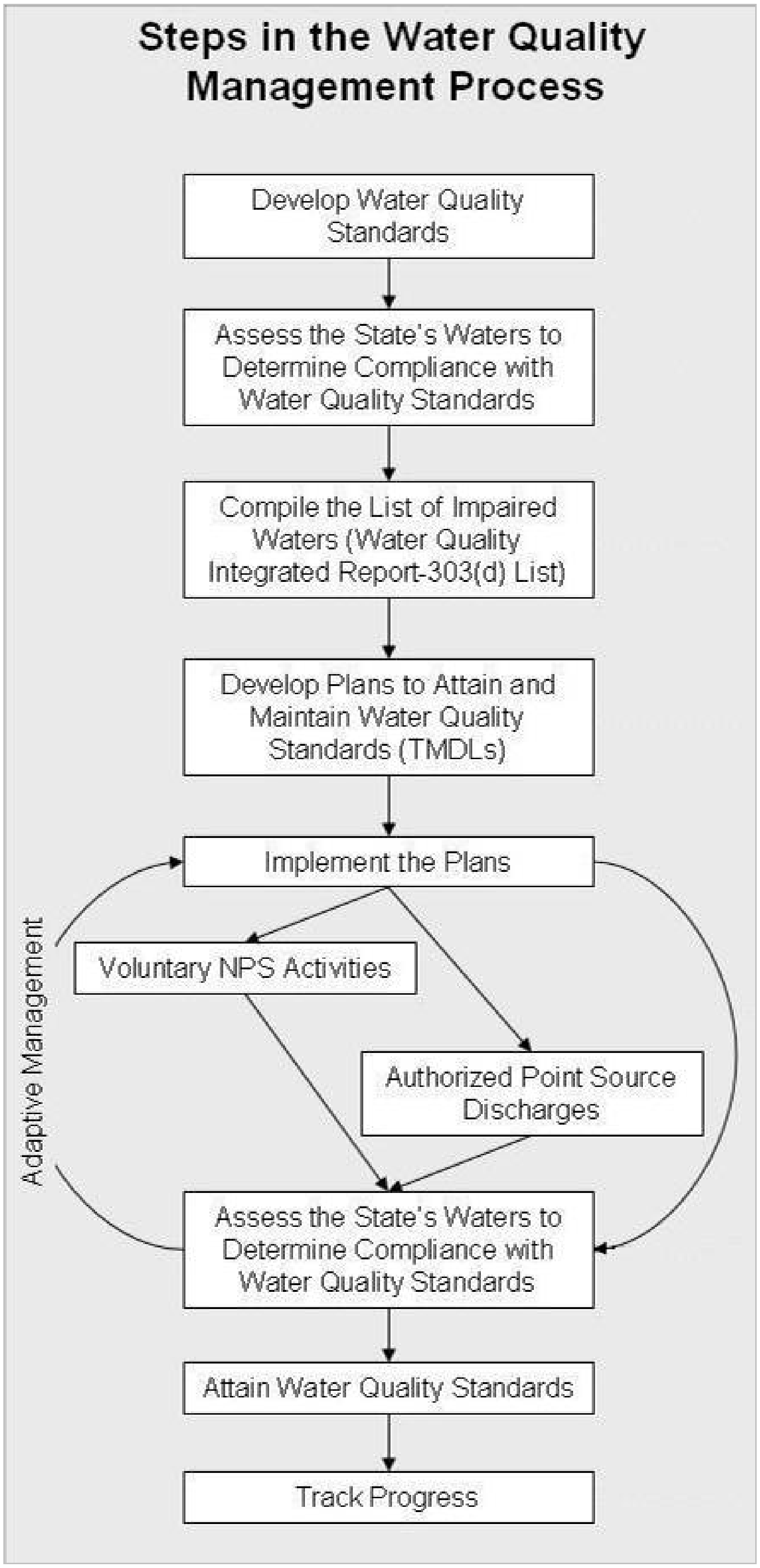


Figure 3-1: Schematic of Montana DEQ's Adaptive Water Quality Management Process

Achieving clean water begins with identifying indicators of desired water quality outcomes, such as targets for clean water (i.e. water quality standards). The next step is to develop overall short- and long-term outcomes, followed by developing a series of program activities. The technical and social outcomes of these activities are monitored and assessed. These assessments are used to identify collaborative adjustments based on new understandings, monitoring results, and lessons learned.

3.1.1 Water Quality Standards and Classification

Montana's water quality standards include the uses designated for a water body (beneficial uses), the legally enforceable standards that ensure that the uses are supported, and a non-degradation policy that protects the existing high quality of a given water body. The Montana Water Quality Act requires the Board of Environmental Review (BER) to adopt water quality standards to protect beneficial uses. The Act also directs the Board to establish permit and nondegradation requirements. Surface and ground-water use classification systems and water quality standards and criteria are defined in the Administrative Rules of Montana, Title 17, Chapter 30, Subchapters 6 and 10.

For most rivers, lakes and streams "beneficial uses" are those uses which the water body supported when the classification system was adopted in 1955, and include future beneficial uses that they should be capable of supporting. Beneficial uses can be grouped in three broad categories: aquatic life support, recreation and water supply.

Aquatic life includes the plants and animals normally associated with a high quality ecosystem. Fisheries use is a more focused element of aquatic life support, and a distinction is made between cold (trout or salmonid) and warm water (non-salmonid) fisheries. Aquatic life support may be impaired by chemical pollutants, sediment, riparian habitat degradation, stream channel modifications, excessive water withdrawal, and other actions that disrupt the integrity of the water body. Recreational uses include activities that involve contact with water such as swimming and boating. Recreational uses may be impaired by noxious growths of aquatic plants or the presence of pathogens. Water supply uses include domestic, municipal, industrial and agricultural uses. Low flow, excessive sediment and suspended solids, high salinity, and other pollutants may impair water supply uses.

Aquatic life support, fisheries, swimming, and drinking water supply generally have the highest water quality requirements. When water bodies fully support these uses, it is reasonable to expect that other uses (such as agricultural and industrial water supply) will also be supported. Conversely, aquatic life, drinking water, and recreational uses may be the first to suffer when water quality is degraded. Water bodies are assessed for each beneficial use (see **Section 3.1.2**). A lake or stream segment might fully support one use, such as industrial water supply, while only partially support another use, such as aquatic life.

Four levels of beneficial use support are used to describe Montana's waters:

1. **Full Support:** Waters are at their natural or best practical condition and water quality standards are attained.
2. **Full Support (Threatened):** The use is currently supported, but observed trends, or proposed new sources of pollution not subject to permitting indicate a high probability of future impairment.
3. **Partial Support:** One or more data types indicate impairment. The state may list a beneficial use as partially supporting uses based on the nature and rigor of the data, as well as site-specific conditions.
4. **Non Support:** One or more water quality standards for the beneficial use are not attained.

Montana, unlike many states, uses a watershed based classification system with some specific exceptions. As a result, all waters of the state are classified and have designated uses and supporting standards. All classifications have multiple uses. Some waters may not actually be used for a specific designated use, for example as a public water supply. Montana's surface water and ground-water numeric criteria are detailed in a single department circular, DEQ-7, Montana Numeric Water Quality Standards (February 2006). At this point in time, wetlands classifications exist only for monitoring purposes and have not been adopted into standards as part of Montana's overall beneficial use classifications.

3.1.2 The 303(d) List and Water Quality Assessment

DEQ has the responsibility for assessing the condition of state waters under the Clean Water Act. Since 2000 DEQ's monitoring focus has been on developing and implementing a process to assess and collect adequate credible data for determining beneficial use support (DEQ 2004c). DEQ data collection efforts have focused on reassessing water bodies lacking sufficient credible data on the reassessment list (DEQ 2006, **Appendix A**). Data collected for these assessments include biological, chemical and physical components. A detailed description of the field methods can be found in the field procedures manual (DEQ 2005f).

Assessed waters that do not meet water quality standards are placed on the State's 303(d) list of impaired waters. Additional monitoring is necessary during and after water quality restoration planning. Over the next five years, DEQ's monitoring and assessment efforts will focus on supporting TMDL and standards development efforts, and in expanding the current statewide monitoring program described in the 2006 Integrated 303(d)/305(b) Water Quality Report. Briefly, this effort includes continuing and expanding a baseline monitoring in reference sites, lakes, rivers and streams across the state using different monitoring designs according to the needs and priorities of the program.

DEQ supports both internal and external monitoring efforts in order to address the many different data needs associated with its NPS management program. DEQ is especially interested in developing a volunteer monitoring program at the watershed level that could provide valuable data on effectiveness of water quality improvement projects and watershed trends.

Monitoring efforts support the Nonpoint Source Program by providing accurate information on appropriate water quality standards, the status of state waters, identification of causes and sources of NPS pollution, and trends in water quality. The monitoring and assessment efforts are integral to ensuring an effective Nonpoint Source Program by focusing the Program on addressing the important pollutant sources and assessing the outcomes of activities taken to address those sources.

3.1.3 The TMDL Process and Water Quality Planning

A TMDL is the allowable pollutant loading from all sources (point, nonpoint, and natural background) established at a level necessary to achieve compliance with applicable surface water quality standards (75-5-103 (32)). Montana State Law (MCA 75-5-703) directs DEQ to develop TMDLs for impaired or threatened water bodies, and TMDL development is also required for these water bodies under the federal Clean Water Act. In accordance with a Settlement Agreement between DEQ, EPA, and Friends of the Wild Swan, all necessary TMDLs for all waters originally listed on Montana's 1996 303(d) List must be completed by December 31, 2012.

In practical terms, a TMDL is a plan to attain and maintain water quality standards for waters that do not currently meet them. Although the TMDL process can be very complex, the basic steps of the process include: developing an understanding of the water quality problem, identifying the sources of the problem (both point and nonpoint sources), quantifying the pollutant loads from each of the sources, allocating load reductions to each of the sources, and establishing water quality goals or endpoints. In Montana, for the specific pollutant or set of pollutants addressed by the TMDL, the TMDL process results in the development of what is called a Water Quality Plan or watershed management plan. Although not required, Montana's WQPs generally also include at least a conceptual restoration strategy or implementation strategy.

In Montana, TMDLs and WQPs are developed using a watershed approach. In this approach, TMDLs are developed for all streams impaired by a given pollutant or set of pollutants within a given watershed. The scale of the watershed used for TMDL development is generally based on USGS Hydrologic Unit Code (HUC - 4th code) boundaries where practical. These watersheds are called TMDL Planning Areas (TPAs).

For at least the next five years, Montana's TMDL Program will be the primary means through which DEQ conducts site-specific and watershed-scale assessments of NPS impacts, quantifies the magnitude of the NPS problem at the watershed scale, develops watershed-scale WQPs, and initiates implementation of NPS restoration measures because:

- 65 percent of Montana's assessed stream miles and 80 percent of Montana's Lakes are impaired, largely due to nonpoint sources.
- TMDLs must be prepared for all of the impaired waters in the state.
- The TMDL process results in watershed scale assessments to identify pollutant sources, quantify pollutant loads, allocate load reductions, and establish water quality goals.
- By court-order, watershed scale TMDLs must be completed for roughly 800 streams

and 30 lakes by 2012.

State law 75-5-703 requires DEQ to provide support to local interests to implement TMDLs and achieve water quality standards. Implementing the TMDLs is the way DEQ will meet its NPS goal of achieving water quality standards for impaired State waters. Local support of the NPS voluntary "reasonable land, soil and water conservation practices" will be necessary in order for implementation and goal achievement. Integration of the TMDL Program with the NPS Program is, therefore, critically important to the success of the NPS Program in Montana.

The TMDL schedule depicted in **Appendix G** is based on DEQ's most recent annual TMDL work planning session that is typically conducted each January. Each year, a revised TMDL schedule is prepared, presenting target completion dates for the current year and subsequent two years. Prioritization factors considered during DEQ's annual TMDL work planning session include:

- Stakeholder interest
- Funding availability
- Significant new pollution sources
- Linkage to discharge permits
- Upstream to downstream staging
- Data availability
- Existing resource commitments
- Additional factors

3.1.4 Water Quality Restoration and TMDL Implementation

NPS control at the watershed level is focused on the restoration of impaired water bodies and the attainment of water quality standards and designated beneficial uses through the implementation of TMDLs. The rationale for the focus on the development of WQPs and TMDLs is that this activity provides a specific strategy for identifying impairment causes and sources and for allocating pollutant loads in a manner that will lead to full attainment of state water quality standards.

Implementation of Montana's NPS Program relies on a combination of voluntary and regulatory elements applied at both the statewide and watershed levels (see **Section 3.1.6**). It has been DEQ's longstanding policy to promote a voluntary program of reasonable land, soil, and water conservation practices to achieve compliance with water quality standards for NPS producing activities. DEQ encourages and supports the efforts of local watershed groups and conservation districts to develop Watershed Restoration Plans (WRPs) that will achieve these objectives.

DEQ will implement TMDLs through prioritizing and providing staff support and funding to those local watershed efforts that pursue NPS controls through development of a WRP and use of adaptive management (see **Section 3.1.5** for more discussion of adaptive management). These WRPs should be viewed as a locally developed "road map", complete with identified funding sources, activities and timelines for meeting state water quality standards as well as other local goals. These plans must be integrated with DEQ's TMDL development efforts, wherever possible.

Local groups are committed to maintaining and preserving their natural resources and have valuable knowledge and experience of local conditions and management practices. Their participation can allow for improved project designs and efficiency in implementation. In addition, valuable partnerships are often formed that promote opportunities for creative problem solving and leveraging funds.

Components of a WRP are listed below.

- Prioritized management practices and treatment areas
- Criteria to measure progress toward meeting watershed goals
- Potential projects
- Monitoring plan / Sampling and Analysis Plan (SAP) to measure success of specific practices, and water quality trends
- Information / Education component
- Evaluation process
- Technical and financial assistance needed to implement the plan
- Implementation schedule
- Interim milestones to track implementation of management measures
- Designated responsibility for reviewing and revising the plan

Assessments of progress and adaptive management should include:

- Information assessment- review and evaluation
- Interagency collaboration and shared results
- Reports back to stakeholders and others
- Adjustments to program

3.1.5 DEQ Five Year Watershed Reviews and Adaptive Management

Once the watershed restoration measures identified in approved WQPs have been implemented, watershed groups and DEQ can systematically assess the overall watershed short- and long-term outcomes, and begin to identify collaborative adjustments based on new understandings, monitoring results, and lessons learned (see **Figure 3-2** for details).

Watershed scale adaptive management involves:

- Setting watershed scale outcomes/goals,
- Selecting categories of tools likely to achieve the desired outcomes,
- Strong stakeholder communication/participation and shared learning,
- Monitoring of both resource integrity (watershed conditions) and social acceptability (social support) of the watershed programs,
- Overall watershed program effectiveness assessment, and,
- Collaborative adjustments during subsequent watershed phases that incorporate the newly resolved uncertainties (resource assessments) and the program lessons learned (social and economic acceptability) from the earlier phases.

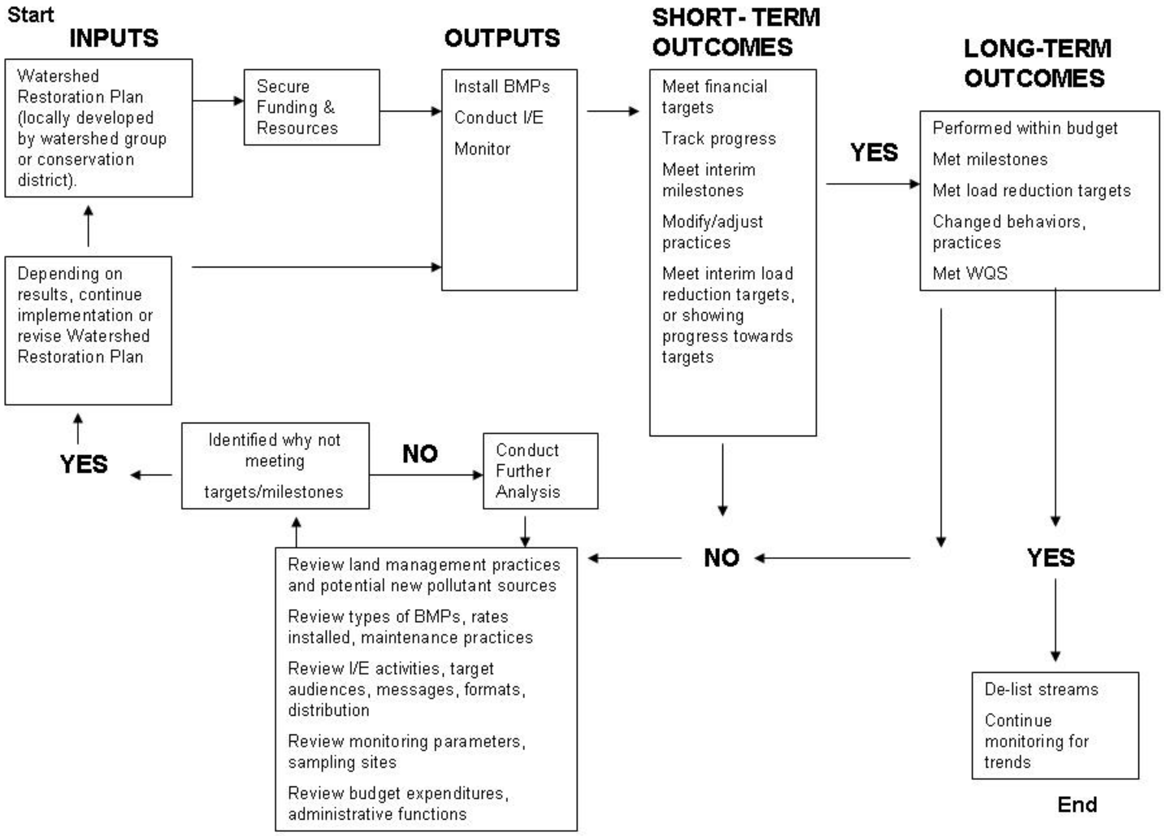


Figure 3-2: Diagram of Adaptive Management Approach for Montana Watershed Restoration Plans

If the beneficial uses of a water body are not fully supported within five years of TMDL or WRP implementation, Montana DEQ is required to conduct a formal evaluation to determine if:

1. Implementation of new or an improved phase of voluntary reasonable land, soil and water conservation practices is necessary.
2. Water quality is improving but more time is needed to meet water quality standards.
3. Revisions to the Plan are necessary to achieve water quality standards.

The criteria below outlines if a TMDL five-year review evaluation is appropriate:

1. TMDLs have been completed in the last five years at a minimum.
2. Conservation District or Watershed Group WRP document is final and the implementation activities identified in the Plan are either underway or have been completed.
3. Progress on restoration activities/projects has been significant and there is a high likelihood that TMDL objectives have been achieved or that significant progress towards attaining goals may be demonstrated.
4. WRP monitoring (identified and implemented by the Plan) has been significant and data is available to evaluate if TMDL objectives have been met.

If the above questions are answered as “yes”, the TMDL is ready for a five-year evaluation. If not, then the adaptive management approach shown in **Figure 3-2** is followed. The framework below describes how TMDL progress is evaluated as part of the five-year review process, following implementation of a WRP. Progress may also be evaluated through the goals identified in the WQP, as not all watersheds will have a locally developed WRP.

- Track watershed restoration progress
- Analyze monitoring data
- Determine potential causes for not meeting implementation milestones (where these exist) and/or TMDL goals and objectives
- Determine potential causes for not making progress toward reducing pollutant loads
- Revise and refine WRP as indicated

3.1.6 Statewide Nonpoint Source Program Emphasis on Pollution Prevention

NPS control at the state-wide level is focused on the protection of waters that currently meet or exceed state water quality standards. Priority activities at the statewide level emphasize pollution prevention, education and coordination through the use of appropriate management practices.

Montana laws address water quality protection from an array of NPS and ground-water issues such as stream crossings, individual sewage disposal systems, strip mines, and land fills. Several state and local agencies are delegated authority to address these issues. For example, the DNRC enforces the Streamside Management Act; the Department of Fish, Wildlife and Parks (FWP) implements the Stream Protection Act; the Department of Agriculture develops and implements regulations and programs regarding the appropriate application of pesticides; and conservation districts administer the Natural Streambed and Land Preservation Act. **Section 4.6** describes most of the important state regulatory authorities which are used to control NPS pollution. There is an obvious need to coordinate the various elements of NPS control both within Montana DEQ and between other local, state, and federal agencies. **Section 4.5** and **Appendix C** of this plan provide considerable detail regarding other agencies and partners that participate in programs to control NPS pollution in Montana.

Adaptive management also plays an integral role in pollution prevention by addressing emerging and new potential threats to clean water. Examples could include developing additional regulatory authorities to address cumulative impacts of septic systems on water quality, and developing additional water quality standards for new pesticides.

The Nonpoint Source Program through the combined strategies of TMDL implementation and pollution prevention taken together will result in meeting this Plan’s goal of attaining and maintaining water quality standards.

SECTION 4.0 MONTANA'S NONPOINT SOURCE POLLUTION CONTROL STRATEGY

This section of the Montana Nonpoint Source Management Plan describes the program goals and objectives, and the state's broad suite of control elements. These include water resource-specific and land use practice-specific measures, public education and outreach (E&O), interagency coordination, and enforceable regulatory elements.

Montana's strategy for addressing NPS pollution includes protection of clean water the use of appropriate management practices also referred to as best management practices, and statewide E&O activities. For waters that are not meetings standards our strategy is to restore those waters through the development and implementation of science-based, locally supported watershed restoration plans.

In the case of impaired waters, application of BMPs may not be sufficient to restore all beneficial uses. The Water Quality Plans and associated TMDLs identify the waste load allocations (point source pollutant loads) and load allocations (NPS pollutant loads) necessary to meet water quality standards. The NPS load allocations are expected to be met through the use of reasonable land, soil and water conservation practices identified in the WQPs and Watershed Restoration Plans.

Montana's water quality programs operate in an integrated fashion to ensure success at the program level and to achieve overall water quality protection and restoration goals. The Nonpoint Source Program has historically and continues to rely on other Department and agency programs in achieving its goals of attaining and maintaining water quality standards. In this update DEQ provides examples of programs that provide regulatory protection for activities that can generate nonpoint source pollution.

4.1 Montana's Nonpoint Source Goals and Objectives

The goal of Montana's Nonpoint Source Management Program is to protect and restore water quality from the impacts of nonpoint sources of pollution in order to provide a clean and healthy environment. The short-term (five-year) goal of Montana's Nonpoint Source Management Program is to demonstrate significant progress in protecting and restoring the water quality of Montana from nonpoint sources of pollution as measured by achieving the actions outlined in this plan. In order to accomplish the goals of the NPS Program, Montana DEQ will use the following principles.

- Support local conservation activities
- Complete comprehensive assessments through the TMDL development process
- Improve collaboration with other programs, agencies, and organizations
- Improve the connection between planning and implementation
- Utilize adaptive management to achieve the goal of the program

4.2 Water Resource-Specific Strategies

This section defines the goals, objectives, and actions that the DEQ's Water Quality Planning Bureau believes are necessary to protect the water resources of Montana from NPS pollution. Separate, yet interrelated strategies have been developed for streams and lakes, wetlands and ground water. As mentioned previously, successful completion of many of the goals, objectives, and actions rely on collaboration with state and federal government agencies, land owners, private groups, and volunteers in attaining and maintaining water quality standards.

4.2.1 Streams and Lakes

Streams and lakes provide many benefits to the people of Montana. Whether for recreation, aesthetics, or dependence for water supplies, all Montanans value these resources. Streams and lakes also offer valuable habitat for riparian vegetation and aquatic plants and animals. All of these uses depend on waters of certain quality and quantity. In order to protect and restore all beneficial uses for Montana's streams and lakes from NPS pollution, coordination of ongoing activities as well as new direction is needed. The state's strategy for stream and lakes outlines broad objectives and actions, leaving room for local direction.

Montana's NPS pollution control strategy for streams and lakes is summarized in **Table 4-1** below.

Table 4-1: Montana's Nonpoint Source Strategy for Streams and Lakes	
Goal 1: Protect Montana's streams and lakes from nonpoint source pollution.	
Objective 1.1: Protect and restore Montana's streams and lakes from nonpoint source pollution.	
Actions:	
1.1a	Complete TMDLs for approximately 850 water bodies and 90 4th code HUCs by 2012.
1.1b	Protect and maintain non-impaired streams and lakes on state, federal, and private lands using science-based land management policies.
1.1c	Continue to monitor and assess Montana's streams and lakes and provide support for volunteer monitoring efforts. Disseminate information on water quality and quantity with an emphasis on status and trends and support of beneficial uses.
1.1d	Foster communication and coordination of water quality monitoring projects conducted by state and federal agencies and private entities, including promoting the use and submission of data to the EPA's Storage/Retrieval (STORET) database, the USGS's NWIS database, and NRIS's Montana Water Quality Monitoring Query System. Promote the use of NRIS so that the National Water Information System (NWIS) serves as a portal to accessing these databases.
1.1e	Assist CDs, watershed groups, and state and federal land management agencies/entities with WQP (TMDL) development and implementation efforts.
1.1f	Promote collaboration between CDs, watershed groups, and state and federal land management agencies/entities to encourage the development of proactive WRPs that address land uses and potential water quality impacts.
1.1g	Fund and provide technical assistance to projects that implement restoration strategies called for in Water Quality Plans and/or Watershed Restoration Plans including activities that lead to the development of a WQP or WRP.

Table 4-1: Montana's Nonpoint Source Strategy for Streams and Lakes	
Goal 1: Protect Montana's streams and lakes from nonpoint source pollution.	
Objective 1.1: Protect and restore Montana's streams and lakes from nonpoint source pollution.	
1.1h	Encourage and support voluntary application of BMPs to protect streams and lakes from nonpoint source pollution.
🎓1.1i	Promote, support, and participate in the efforts of the Montana Watershed Coordination Council through website development and expanding information distribution.
🎓1.1j	Continue to provide public education on the value and importance of protecting streams and lakes from nonpoint source pollution. Campaigns should target land managers, stakeholders, as well as the public.
🎓1.1k	Increase program support to volunteer monitoring efforts to include pilot certification volunteer monitoring project.
Objective 1.2: Continue to use permitting, licensing, certification, and non-regulatory approaches to protect streams and lakes.	
🎓1.2a	Consult and assist with regulatory programs that protect streams and lakes from NPS pollution.
🎓1.2b	Increase the protection of sensitive lands along watercourses from encroachment and development, and promote riparian buffers adjacent to stream and lakes through education and outreach efforts.
Objective 1.3: Develop tracking system for water quality BMPs and restoration activities.	
Actions:	
1.3a	Encourage collection of appropriate implementation and effectiveness monitoring strategies for NPS projects.
🎓1.3b	Continue to work with Montana Water Center to update current web-based water quality project tracking database.
🎓1.3c	Develop a GIS mapping database at a watershed scale to track BMP installation and watershed restoration projects, grants funded, and volunteer monitoring programs.
🎓1.3d	Coordinate development and publication of Montana NPS success stories.

Note: The 🎓 symbol denotes an education & outreach action

4.2.2 Wetlands and Riparian Areas

Wetlands and riparian areas can play a critical role in reducing nonpoint source pollution by intercepting surface runoff, subsurface flow, and certain ground-water flows. Their role in water quality improvement includes processing, removing, transforming, and storing such pollutants as sediment, nitrogen, phosphorus, and certain heavy metals. Research also shows that riparian areas control the release of herbicides into surface waters (EPA 2005a). Thus, wetlands and riparian areas buffer receiving water from the effects of pollutants and/or prevent the entry of pollutants into receiving waters. It is important to consider that degradation of wetlands and riparian areas can inhibit their ability to treat NPS pollution, and degraded wetlands and riparian areas can also become sources of NPS pollution.

Wetlands and riparian areas, therefore, should be protected to the maximum extent possible from changes that would degrade their natural functioning. Often, BMPs are combined in a resource management system in order to more effectively protect existing wetland functions and resources. Examples of systematic BMPs that can be used to provide preliminary treatment for runoff headed for wetlands include: multiple pond systems, grassed swales combined with retention ponds, and grassed swales leading to vegetated filter strips, followed by infiltration trenches. Finally, degraded wetlands and riparian areas should be restored where possible.

The Montana DEQ's Technical and Financial Assistance Bureau (TFAB) is responsible for coordinating and providing leadership to statewide wetlands conservation activities. One activity is to staff and provide leadership to the Montana Wetland Council. The Council meets quarterly and acts as a forum for all stakeholders to participate in wetland issues. With DEQ leadership, the Council developed a draft conservation strategy for Montana's Wetland and Situation Assessment, which guides the Council in pursuing wetland conservation activities. Wetland conservation priorities are funded by an EPA grant program administered by the DEQ wetland coordinator.

Montana's NPS pollution control strategy for wetlands and riparian areas is summarized in **Table 4-2** below.

Table 4-2: Montana's Nonpoint Source Strategy for Wetlands	
Goal 2: Montana wetlands will be identified and their natural functions including NPS pollutant reductions will be protected.	
Objective 2.1: Protect/restore naturally functioning wetlands and riparian areas from adverse effects.	
Actions:	
2.1a	Continue to identify, assess, classify, and map Montana wetlands as part of the DEQ Wetlands program and the MT NHP Wetland and Riparian Mapping Center.
2.1b	Protect and maintain natural wetlands and riparian corridors on state, federal (USFS and BLM), and private lands.
2.1c	Assist local watershed groups and conservation districts to obtain funding for wetland and riparian protection and/or restoration.
2.1d	Use preliminary treatment BMPs such as vegetated filter strips or retention basins to prevent adverse impacts on wetland functions.
2.1e	Support the coordination of local, state, and federal efforts to protect and restore wetland/riparian function in Montana.
2.1f	Create education & outreach material explaining differences between natural and constructed wetlands, including manuals on how to construct effective wetlands.
2.1g	Collaborate with Montana Wetlands Council to achieve 10 year strategic framework for wetlands protection and conservation.
2.1h	Continue to provide public education on the value and importance of wetlands and riparian areas for wildlife habitat, species diversity, flood control, hydrology of surface water and ground water, NPS abatement, and water quality through targeted workshops focusing on constituents such as construction companies, realtors, agricultural producers, etc.
2.1i	Develop interagency outreach materials as part of the Governor's riparian protection initiative, which could include advertising campaign, logo production to target developers and large acreage, new landowners.
2.1j	Remarket publications for different targeted audiences promoting importance of wetlands; Continue to promote wetlands website.

Table 4-2: Montana's Nonpoint Source Strategy for Wetlands	
Goal 2: Montana wetlands will be identified and their natural functions including NPS pollutant reductions will be protected.	
Objective 2.2: Use permitting, licensing, certification, and non-regulatory approaches to protect wetland functions.	
Actions:	
2.2a	Encourage/advocate for the protection of sensitive lands along watercourses from encroachment and development, and promote ecological transition areas or buffers adjacent to wetlands.
2.2b	Assist and cooperate with Federal, State, and local regulatory programs to counteract wetland/riparian encroachment resulting from new development.
Actions:	
Objective 2.3: Utilize constructed wetlands as a BMP where appropriate to improve water quality.	
2.3a	Promote constructed wetlands, riparian corridors, and vegetated filter strips for sources of agricultural and urban NPS runoff (i.e. storm water, effluent treatment).
2.3b	Explore alternative technologies for constructed wetland water quality improvement.

Note: The symbol denotes an education & outreach action

4.2.3 Ground Water

Ground water is the primary source of drinking water for Montanans who live outside of city boundaries as well as those who are on public water systems. In many cases, ground water is also the primary source of water in streams and rivers during the fall and winter 'baseflow' period, and may be the primary source of lake water. Additionally, ground water is vital to wetlands. Because ground water is not easily seen, except in the case of springs, it is often not considered until a problem exists. In order to protect and restore Montana's ground-water supplies from NPS pollution, coordination of ongoing activities as well as new direction is needed. The state's strategy for ground water outlines broad objectives and actions, leaving room for local direction. Because actions that protect ground-water supplies will ultimately benefit surface waters and vice versa, additional actions have been listed below that will facilitate the coordinated protection and management of ground-water and surface water resources.

Montana's nonpoint pollution control strategy for ground water is summarized in **Table 4-3** below. **Appendix B**, Montana's Ground-Water Quality Protection Strategy, discusses existing programs in place at the state level in Montana that are designed to protect ground water, and ultimately defines the role of the State's 319 Program within this context. This appendix also provides suggested updates and outlines new direction to the *Montana Ground-Water Plan* for the Department of Environmental Quality's 319 Nonpoint Source Grant Program, and proposes strategies for the successful implementation of these new directives.

Table 4-3: Montana's Nonpoint Strategy for Ground Water	
Goal 3: Protect Montana's ground-water resources from nonpoint source pollution.	
Objective 3.1: Protect and restore Montana's ground water from nonpoint source pollution.	
Actions:	
3.1a	Protect high quality aquifers on state, federal, and private lands using science-based land management policies.
3.1b	Continue to monitor and assess Montana's ground-water resources and disseminate information on aquifer vulnerability, particularly in areas where a vulnerable aquifer serves as a drinking water source or is directly connected to an impaired surface water body.
3.1c	Foster communication and coordination of water quality monitoring projects conducted by state and federal agencies and private entities, including promoting the use and submission of data to the EPA's SDWIS and STORET databases, MBMG's GWIC database, the USGS's NWIS database, and NRIS's Montana Water Quality Monitoring Query System. Promote the use of NRIS so that the Water Information System serves as a portal to accessing these databases.
3.1d	Support projects that implement restoration strategies called for in an existing WQP (TMDL) or include activities that will lead to the development of a WQP.
3.1e	Promote collaboration between CDs, watershed groups, and state and federal land management agencies/entities to encourage the development of proactive and collaborative WRPs that address land uses and their potential ground-water quality impacts.
3.1f	Encourage and support voluntary application of BMPs to protect ground water from NPS pollution.
3.1g	Continue to promote, support, and participate in the efforts of the Montana Watershed Coordination Council and the Ground Water Work Group through website development and expanding information distribution.
3.1h	Continue to provide public education on the value and importance of protecting ground-water resources from NPS pollution (i.e. general awareness of ground water, identification of recharge areas and limitation of activities that pose threats to ground-water contamination in recharge areas, and proper well installation and decommissioning).
3.1i	Protect high quality aquifers on state, federal, and private lands using E&O strategies, such as signs in Missoula that note the distance to its sole-source aquifer.
3.1j	Promote Ground Water Awareness Week each year from March 11-17 through promotion of success stories and press releases.
3.1k	Promote World Wide Monitoring Day each year on October 18 through promotion of success stories and press releases.
3.1l	Collaborate internally with the DEQ's Source Water Protection Section on education and outreach needs to promote the protection of source water areas, including septic system and well maintenance for home owners.

Table 4-3: Montana's Nonpoint Strategy for Ground Water	
Goal 3: Protect Montana's ground-water resources from nonpoint source pollution.	
Objective 3.2: Continue to use permitting, licensing, certification, and non-regulatory approaches to protect ground-water resources.	
Actions:	
3.2a	Assist counties, municipalities, and other entities to institute programs that protect ground water from nonpoint source pollution (i.e. measures for the maintenance of septic systems, protection of riparian areas and wetlands, standardized pump test procedures for subdivision well minimum flow requirements in closed basins).
3.2b	Collaborate with local entities on education and outreach activities that will fit the unique community needs within their watersheds.
Objective 3.3: Help facilitate the coordinated protection and management of ground-water and surface water resources.	
3.3a	Encourage watershed based water balance studies. A water balance study could be an important component to include within a Watershed Restoration Plan so that water availability and water uses are quantified and the water use impacts on water quality are identified.
3.3b	Fund and provide technical assistance for projects that focus on the effects of ground-water and surface water interactions in relation to water quality impairments identified on the 303(d) list.
3.3c	Provide information on the benefits of centralized distribution and treatment of water and wastewater in new developments to encourage community wells and community wastewater treatment systems, or connections to existing centralized systems. Target audiences include city and county commissioners as well as DEQ Permitting Division.
3.3d	Encourage and promote participation in national and state affiliated workgroups that focus on ground-water and surface water interactions. Examples include MWCC, Soil and Water Conservation Society (SWCS), American Water Resources Assoc. (AWRA), American Ground Water Trust (AGWT).
3.3e	Assist counties with the formation of Local Water Quality Districts through outreach and education efforts, when there is citizen interest and local expertise available to manage a district.
3.3f	Promote voluntary nutrient reduction programs in rapidly growing areas of the state and/or where elevated nutrient loading to state waters is a concern. New programs in the state could be modeled after the Tri-State Council's Clark Fork River Voluntary Nutrient Reduction Program implemented in 1995, which discontinued the sale of phosphate detergents in area markets.

Note: The symbol denotes an education & outreach action

4.3 Land Use-Specific Strategies

Section 2.2 provided information on various nonpoint (diffuse) pollution sources. These sources are a result of our diverse activities upon the landscape. Pollution from point sources (conveyed by a discrete "pipe" or source) is controlled by the state through discharge permits, and is often treated by engineered facilities (e.g. wastewater treatment plants). Because of its diffuse and varied nature, addressing NPS pollution requires a holistic and yet varied approach. The actions outlined in the sections below provide specific management practices based on land use sources that have been identified as causing water quality problems in Montana. Taken together they provide the actions necessary to protect and restore Montana's water quality from NPS pollution.

4.3.1 Agriculture

Agriculture is central to the culture and lifestyle of Montana and the dominant land use, and is a significant contribution to the economy of the state. Although crop and livestock production account for the largest percentage of NPS water quality impairment in Montana (DEQ 2006[2]) this is primarily because it comprises our largest land use. Pollution may result from erosion, runoff of fertilizers, livestock manure, and pesticides, in addition to alterations in watershed hydrology, riparian habitat, and stream bank stability. There is no single, ideal practice for controlling the various pollutants that result from farming and ranching. Instead, site specific management plans should be designed based on the type of pollutant, source, cause, environmental conditions (climate, soil type etc), and economic considerations of the producer.

Erosion of cropland and subsequent sediment and pollutant delivery can occur during winter and spring snow melt as well as heavy rainfall events when soil surfaces are unprotected by plant growth or crop residues. Agricultural practices, including subsurface tile drainage systems, constructed waterways, and drainage ditches, have eliminated or fragmented natural filtration systems which slow and purify runoff. The results are often a compressed and exaggerated hydrograph. In addition, activities which create impervious surfaces or reduce infiltration have a similar impact on runoff and the hydrograph. These practices allow a greater proportion of precipitation to run off the surface instead of infiltrating into the soil. This runoff may become concentrated into rills and gullies which accelerate erosion. The concentrated runoff and sediment enters streams more quickly which causes stream flow volume to peak more quickly and in many cases at a higher level than would otherwise occur.

Management practices exist that assist in preventing the availability, transport, and delivery of NPS pollutants to receiving water resources by:

- Minimizing pollutants available (source reduction);
- Reducing the flow rate of runoff to allow for deposition of the pollutant or infiltration of runoff; and/or
- Remediating or intercepting the pollutant through chemical or biological transformation.

4.3.2 Effective Farming Practices for Managing NPS Pollution

Effective and well documented agricultural BMPs which reduce NPS pollution impacts on surface and ground-water quality include conservation tillage, vegetated filter strips or buffer strips, precision farming, organic farming, and saline soil and water reclamation. These are each described in more detail in the following sections.

[2] All sources are probable until the source assessment of the TMDL is able to quantify the relative contributions of natural sources and all point and nonpoint sources.

Conservation Tillage

Conservation tillage is now promoted widely by a large number of groups and organizations because it is both profitable and effective in controlling erosion. Currently in Montana, 2.25 million acres are farmed using true no-till technology where the soil is not disturbed at all except at seeding time (R. Fashing, NRCS, personal communication, 3/14/07). Application of no-till technology has been increasing in Montana over the last 15 years, and is supported by Natural Resource Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) funding throughout the state at this time. The Conservation Technology Information Center (1997) reported that on average, no-till resulted in 93 percent less erosion and 69 percent less water runoff than moldboard plowing (EPA 2003a). Other benefits include: time and labor savings, fuel savings, decreased machinery wear, improved soil tilth, increased organic matter, carbon sequestration, increased soil moisture, increased wildlife, and improved air quality. Further information may be obtained from the Pacific Northwest Direct Seed Association website: http://www.directseed.org and the Conservation Technology Information Center: http://www.ctic.purdue.edu.

Vegetated Filter Strips

Vegetated filter strips (VFS) coupled with additional farming practices that reduce nutrient inputs or minimize soil erosion, can also be an effective management practice for the control of NPS pollution from agricultural sources of sediment, phosphorus, bacterial contaminants, and heat loading. Several studies of VFS show sediment removal rates of 70 percent. The effectiveness of VFS in nutrient removal is more variable, but nitrogen and phosphorus removal rates are typically greater than 50 percent (EPA 2005a). In general, stream corridor riparian areas have been shown to provide numerous water quality benefits. These include removing pollution from runoff, stabilizing streambanks, maintaining shade needed for lower water temperatures, and providing diverse aquatic habitats. The preservation and protection of these areas is important for other benefits as well, including floodwater storage, erosion control, ground-water recharge, and maintenance of biological diversity. Direct benefits of wetlands and riparian buffer strips to agriculture include maintaining late summer stream flows which are critical for irrigating crops, watering stock, and recharging aquifers; reducing floodwater velocities and energy; maintaining a higher water table which increases subsurface irrigation and forage production; filtering sediments, nutrients and pesticides; prolonging life of irrigation pumps, reducing siltation of irrigation ditches; and providing shrubs and trees that shelter livestock. For more information about conservation buffers, visit: http://www.nrcs.usda.gov/feature/buffers.

The Farm Service Agency's (FSA) Conservation Reserve Program Continuous Sign-Up offers financial incentives to make conservation buffers economically attractive for farmers and ranchers. Annual rental and maintenance payments are made for acres converted to buffer strips, in addition to cost share payments for installation of needed practices. Nationally, studies have shown significant economic benefits associated with vegetative treatment systems for reducing water treatment costs. In Iowa and Ohio, a $2.7 million per year benefit was estimated based on a 25percent sediment reduction from vegetative treatment (EPA 2005a).

Precision Farming

Precision farming may reduce NPS pollution through integrated agricultural management which better evaluates localized field conditions. Producers utilize new technologies, including global positioning systems (GPS), sensors, satellites or aerial images, and GIS, to assess and understand field variations. The collected information is then used to more precisely estimate planting density, apply fertilizers and other chemicals, and predict crop yields. Fertilizer and herbicides that would have been spread in areas that don't need it can be placed in areas that do, thereby maximizing profits and potentially reducing runoff from excess agro-chemical applications. Other benefits of precision agriculture include better time management and increased efficiency (EPA 2003a).

Organic Farming

Organic farming is another approach which reduces the potential for surface and ground-water pollution by eliminating the application of synthetic pesticides and fertilizers. Since the 1990's, the retail market for organic farming has grown about 20 percent annually due to increasing consumer demand. Currently in Montana, approximately 209,000 acres of the state's 5 million acres of wheat fields are organically managed. However, Montana rates first in the nation for organic wheat production, and second for organic production of other grains, including peas, lentils, and flax. In this way producers are filling a market niche while using fewer chemicals (Western 2005). NRCS offers incentives for farmers transitioning to organic production through the EQIP Program. The following websites offer further information on organic agriculture: http://www.mt.nrcs.usda.gov/technical/organic and http://www.aeromt.org.

Saline Soil and Water Reclamation

More than 300,000 acres of Montana's farmland is affected by high natural salt content of native soils (MT Salinity Control Association). Soil and bedrock in central and eastern Montana have an elevated and highly soluble salt content due to old seabed deposits. The large scale crop–fallow farming practices which began in the 1940s created saline seeps due to readily available natural saline sources. Saline seeps are formed when water, in excess of what can be stored in the annual crop-rooting zone or used by growing crops, dissolves salts in the soil and leaches down to build up a shallow water table on top of the bedrock or an impermeable soil layer. The level of the artificially created water table gradually rises until it reaches the soil surface to evaporate and leave a white salt crust. Over time the soil becomes less productive and plant growth is reduced or eliminated. Saline ground water, which can be nearly as salty as seawater, also enters rivers, lakes and streams impairing water quality.

Saline seeps have negative economic and environmental impacts. By applying appropriate techniques, future seeps can be prevented and existing seeps can be reclaimed, allowing cropland and grazing land to be brought back into and remain in productive use. The majority of salinized acreage in Montana is impacted by sulfate-based salts and considered recoverable. The Montana Salinity Control Association (MSCA), a satellite program of 34 conservation districts was created to assist with saline soil and water reclamation. Farmers can voluntarily work with MSCA to recover salinized lands through local conservation districts and United States

Department of Agriculture (USDA) farm programs including the NRCS EQIP and FSA Conservation Reserve Program (CRP). Saline recharge areas may be managed by rotating from annual crop production to deep-rooted perennial crops to gradually lower the static water level and control the saline discharge. Recharge areas may be located through ground-water investigations or through GIS-based modeling tools, using soil layers, topography, and climate information. The TMDL program is utilizing this assessment approach to locate potential recharge areas and recommend saline management strategies in watershed restoration plans.

MSCA provides ground-water assessments and site-specific reclamation plans for individual landowners and groups in small and large scale watersheds. The reclamation process improves soil conditions and protects the ground water, streams and other aquatic resources. At one time over 300,000 acres of formerly productive land had become salinized in Montana, not including range and riparian areas. Land use changes have brought much of that land back into production, and have helped to prevent further contamination of ground and surface water.

Since the MSCA program began, over 1,000 saline sites have received site-specific recommendations. Currently, there are over 100 projects in progress or waiting for technical and financial assistance. MSCA is also assisting with 14 watershed- scale saline projects, ranging in size from 5,000 acres to over 600,000 acres. For further information, contact the MSCA at MSCA@3rivers.net

Whole Farm and Ranch Planning

FSA and NRCS encourage developing individual water quality plans for farms, ranches, and small acreages. These can be a component of an implementation strategy for a WRP. Developing a farm plan should incorporate water quality goals and alternatives that are shared or common to the larger watershed. This farm plan enables a landowner to look critically at how activities impact water quality in the watershed and help integrate BMPs into the overall operation. The farm plan should include business management, crop rotation, animal husbandry, pest and fertility management, and wildlife habitat. The water quality component of the farm plan might address soil erosion, irrigation management and return flows, range management, nutrient management, pesticide use, and riparian area protection or restoration. It is not always possible, or even necessary, to separate water quality measures from other components of farm management. For example, reducing soil erosion (a water quality practice) maintains the productivity of the soil and the sustainability of the farm as a business.

Most whole farm plans include goals and specific objectives. A goal is a general statement of purpose or intent. A whole farm goal might be to “sustain the productivity of the soil.” Objectives are specific, quantified, and measurable: “increase soil organic matter from 1.5 to 2.5 percent;” “establish 1,500 feet of riparian forest buffer.” A good farm plan includes a timetable for meeting objectives and includes a monitoring strategy for evaluating success. Equipped with some fundamental training from the Montana Volunteer Water Monitoring Program (mtwatercourse@mt.edu), a landowner can track the health of a stream over time. He or she can also use other indicators to document progress, such as photo points taken at strategic sites on the farm or ranch. Over time these photos will indicate how the land is responding to alterations of management. Indicator species can also be used for gauging the health of the farm ecosystem.

The landowner may perform an annual or biennial census of a few wildlife species that demonstrate the land's diversity and vigor.

A family farmer or rancher can utilize the expertise of the local conservation district, MSU Extension Program, NRCS, Department of FWP and other resource agencies to develop a farm plan. For many farmers, ranchers and small landowners, a whole farm plan can be an important tool in meeting their economic and environmental goals. It can also be a tool for local watershed groups to measure progress and achieve targets. Conservation districts and watershed groups could take the lead in advocating for the development of whole farm plans. DEQ's role would be to provide resources to local groups and publicize their efforts.

Agriculture Strategy

Montana's agriculture NPS pollution mitigation goals include not only increasing implementation of farming, range land, and animal feeding operation (AFO) BMPs but also improving irrigation water management. Montana adopted "Agricultural BMPs for Control of Nonpoint Source Pollution" based on Montana Conservation Practice Standards from the Natural Resources Conservation Service's Technical Guide as a framework for implementing this strategy (See **Appendix A**). It is recommended that these BMPs be applied on a site specific basis as part of the comprehensive farm plan. Numerous federal and state agencies and programs provide technical assistance and financial incentives to implement these BMPs.

In addition to advocating agriculture BMPs, DEQ's TMDL Program allocates pollutant loads using a watershed approach wherever NPS pollutants impair a water body's beneficial uses. A watershed approach focuses on targeting priority water quality problems, promoting stakeholder involvement, integrating solutions that make use of the expertise and authority of multiple agencies, and measuring success through monitoring and data gathering. The WQPs developed as a result of the TMDL Planning efforts include an implementation strategy, which identifies critical steps toward restoring full support to beneficial uses. Montana's leading agriculture organizations are represented on the Statewide TMDL Advisory Group and have participated in the development of agriculture BMPs. **Table 4-4** below, summarizes Montana's agricultural NPS pollution control strategy.

Table 4-4: Montana's Nonpoint Source Agricultural Strategy

Goal 4: Sustainable agricultural land management will maintain agricultural resources while protecting water quality.

Objective 4.1: Provide agency support for assisting to implement watershed group and conservation district agricultural watershed restoration plans and increase implementation of agriculture BMPs.

Actions:

4.1a	Clarify and identify state agency roles and obligations for developing and implementing agricultural watershed restoration plans through interagency collaboration.
4.1b	Develop a Montana Agricultural Strategy based on the NPS Plan goals to coordinate and implement all the NPS agricultural sector activities in the state. This document would clearly define roles and responsibilities of state agencies for NPS pollution control and watershed restoration activities linked to TMDL implementation.
4.1c	Continue to collaborate with Department of Natural Resources and Conservation to implement Watershed Restoration Plans and BMPs on state-owned lands with impaired waters.
4.1d	Provide assistance to CDs and Watershed groups for developing, implementing and funding agricultural watershed restoration plans.

Objective 4.2: Continue to collaborate with agriculture producers and their membership organizations to implement agricultural BMPs and watershed restoration projects.

Actions:

4.2a	Develop a Memorandum of Understanding (MOU) with the Montana agricultural organizations to assist in implementing water quality programs.
4.2b	Assist farmers and ranchers to identify potential sources of pollution and helping them obtain technical or financial assistance to address water quality problems.
4.2c	Coordinate and promote outreach tools to agricultural organizations to include: making presentations to agriculture organizations; writing articles for farm publications, radio, and television stories, helping to organize watershed groups and encourage farmers and ranchers to participate in the watershed planning process; serving as a liaison between agriculture producers and resource agencies.
4.2d	Promote alternative energy crops such as camelina to increase longevity and diversity of agricultural areas.

Table 4-4: Montana's Nonpoint Source Agricultural Strategy	
Goal 4: Sustainable agricultural land management will maintain agricultural resources while protecting water quality.	
Objective 4.3: Promote BMP implementation to address NPS pollution on a watershed basis. (See Appendix A for list of BMPs)	
Actions:	
4.3a	Work with watershed groups, conservation districts, irrigation districts, and district councils to develop local watershed restoration plans, and obtain funding and technical resources for implementation.
4.3b	Encourage farmers and ranchers to take advantage of low interest State Revolving Fund (SRF) loans to finance the implementation of NPS BMPs. Help local groups identify other financial and technical resources for BMP implementation. See Appendix E for list of financial resources.
4.3c	Promote the continued adoption of conservation tillage (no-till, direct seed) practices throughout the state.
4.3d	Collaborate with the Montana Salinity Control Association, DNRC, NRCS, MBMG to assist local watershed groups in setting salinity reduction goals and identifying appropriate BMPs.
🎓4.3e	Provide access and increase awareness to grant opportunities provided by different federal and state agencies, non-profit organizations.
🎓4.3f	Collaborate with state and federal land management agencies to identify agriculture-related education and outreach needs, and develop public education strategies. These should include E&O strategies for each locally developed "Watershed Restoration Plan".
🎓4.3g	Assist watershed groups, irrigation districts, and conservation districts to develop outreach strategies to promote BMP implementation. This might include demonstration projects, articles in local newspapers, public service announcements on television and radio stations, and presentations to local farm organizations, as well as one on one contact with farmers and ranchers in the watershed. Follow Flathead Lakers Education & Outreach Strategy for example.
🎓4.3h	Promote education highlighting the important functions of wetlands and riparian areas. Encourage the protection of natural wetlands and riparian areas and installation of vegetated filter strips and buffer strips along stream corridors in agricultural lands.
🎓4.3i	Publicly promote two most identified important BMPs: 1) conservation tillage & 2) buffers for riparian areas. Both assist producers economically and environmentally over short and long term.
Objective 4.4: Implement watershed restoration plans and BMPs on state owned agricultural lands.	
Actions:	
4.4a	Develop resource conservation plans with site specific BMPs for state leased agricultural lands. Utilize a phased approach, as leases are renewed, beginning with state lands in 303(d) listed impaired watersheds with linkages to agricultural pollution concerns.
4.4b	Maintain natural riparian areas and/or install vegetated filter strips with native vegetation along stream corridors on state agricultural and grazing lands.
4.4c	Collaborate with DNRC to implement NPS and TMDL Water Quality Plans on state owned lands.

Note: The 🎓 symbol denotes an education & outreach action

The following sections provide more discussion on nonpoint problems and remedies for three specific categories of agriculture – irrigated agriculture, grazing, and AFOs.

4.3.3 Irrigated Agriculture

There are 2.13 million acres of irrigated farmland in Montana. Gravity flow irrigation systems are utilized on 1.36 million acres, 770,000 acres are sprinkler irrigated, and 3,600 acres utilize sub-irrigation. Fourteen percent of irrigation water comes from ground-water sources and 86 percent from surface waters (Montana Agriculture Statistics Service. www.nass.usda.gov). Important irrigated crops include wheat, alfalfa, barley, oats, sugar beets, potatoes, corn and cherries. The 2006 Montana Integrated Report[3] identified flow alteration from water diversions and irrigated crop production as the cause of beneficial use impairment in numerous water bodies. Pollution from irrigation activities includes flow alterations, bank erosion, channel incisement, dewatering, water level fluctuation, and habitat degradation. Increased loading of the following pollutants may occur: nutrients, selenium, salinity, temperature (heat loading), and sediment.

Irrigation return flows and flow fluctuations erode stream banks and streambeds and contribute sediment, nutrients, and pesticides to receiving surface waters. Irrigation withdrawals may also impair streams by reducing stream flow. This can lead to higher water temperature, reduced riparian vigor, a reduction in suitable aquatic life habitat, and sometimes increased downstream concentrations of nutrients or sediment deposits. Increased irrigation efficiencies (i.e. sprinkler irrigation) may also in some instances adversely impact downstream water bodies by diminishing flood irrigation induced ground-water recharge. This recharge may have previously helped maintain adequate late season flows. Thus irrigation system changes should be carefully evaluated to avoid unintended consequences.

Several conservation districts and watershed groups have had considerable success in restoring water quality by improving irrigation efficiency. For example, replacing an open ditch with a pipe and converting some fields from flood to sprinkler irrigation saved enough water to guarantee late stream flows in the Big Creek Watershed in Park County. Historically, there was no incentive for farmers to conserve irrigation water. Water rights doctrine was pretty much "use it or lose it." However, in 1989 the law was amended to allow water rights to be leased for in-stream uses. The Natural Resources Conservation Service estimates seventy percent of Montana irrigation systems could use improvement in irrigation water management, on-farm irrigation systems, and irrigation water conveyance. Improved irrigation water management in conjunction with in-stream water leasing not only improves stream flows, it also reduces the amount of sediment, pesticides, and nutrients entering Montana’s surface water.

Energy for pumping and applying water is a major cost of production for many irrigators. The advantages and disadvantages of different irrigation types and management techniques must be carefully evaluated for energy efficiency and water quality effects on a site specific basis.

Montana’s NPS pollution control strategy for irrigated agriculture is summarized in **Table 4-4-1** below.

[3] All sources are probable until the source assessment of the TMDL is able to quantify the relative contributions of natural sources and all point and nonpoint sources.

Table 4-4-1: Montana's Nonpoint Source Agricultural Strategy for Irrigation	
Goal 5: Increase irrigation efficiency and the application of BMPs to augment stream flow and improve water quality while increasing profitability for irrigators.	
Actions:	
Objective 5.1 Improve irrigation water management	
5.1a	Assist watershed groups identify resources for improving irrigation water management.
5.1b	Collaborate with other resource agencies and nonprofit organizations to demonstrate and promote water conservation technologies.
5.1c	Assist with projects to better understand local ground and surface water interactions and the potential impact of irrigation systems on late season flow.
5.1 d	Continue to publicize and promote the Bureau of Reclamation's AgriMet automated weather stations http://www.gp.usbr.gov/agrimet/agrimet.htm which provides climatic data and crop water use information to assist farmers in irrigation scheduling and application.
5.1e	Work with NRCS, conservation districts, irrigation districts, watershed groups and agriculture organizations to provide irrigators with information and training on using modern technologies to monitor air and soil temperatures, soil moisture, evaporation, relative humidity, crop water use, and other factors that influence irrigation scheduling.
Objective 5.2: Upgrade obsolete and inefficient irrigation delivery systems in order to improve stream flows.	
Actions:	
5.2a	Help watershed groups identify public and private resources for improving irrigation infrastructure.
5.2b	Promote the Pollution Control State Revolving Fund Program to provide low interest loans to irrigation districts and similar entities.
5.2c	Demonstrate and publicize alternative energy technologies for irrigation pumping and delivery. Display at local fairs, workshops, trainings etc.
Objective 5.3: Achieve water quality standards by implementing irrigation BMPs identified in water quality plans and local watershed restoration plans.	
Actions:	
5.3a	Work with conservation districts, irrigation districts, watershed groups, MSU Extension, agriculture organizations and other resource agencies in developing, refining and promoting BMPs for irrigated agriculture.
5.3b	As part of TMDL implementation process, assist watershed groups in estimating potential pollutant reductions and/or documenting water quality improvements from specific BMPs.
5.3c	Coordinate with Montana State University and publicize successful restoration, ground water, and TMDL implementation projects through DVD distribution and video clip technology on DEQ website.

Note: The symbol denotes an education & outreach action

4.3.4 Pasture and Range Lands

Grazing on pasture and range land occurs on 39.9 million acres in Montana and is one of the state's leading sources of NPS pollution (DEQ 2006[4]). Grazing activities contribute to impairment of 5,200 miles of streams and account for a large percent of the state's nonpoint pollution. There are approximately 2.4 million cattle utilizing grazing lands in Montana. In

[4] All sources are probable until the source assessment of the TMDL is able to quantify the relative contributions of natural sources and all point and nonpoint sources.

addition, there are 19,000 cows contained on 650 dairies throughout the state (Montana Agriculture Statistics Service. www.nass.usda.gov).

The principal pollutants of concern associated with grazing activities are bacteria, nutrients, sediment, and stream temperature alteration. Pollutants from animal waste may be transported from range and pasture land and leach into subsurface waters. Overstocking of pastures and range lands, inadequate growing-season rest, or prolonged seasonal use can lead to plant community changes and an increase in bare soil which may cause these lands to be more susceptible to erosion. Overgrazing of riparian areas can impact riparian and wetland vegetation and may cause stream heat loading and bank erosion. The loss of riparian cover also results in reduced filtering of several pollutants, including nutrients, sediment and bacteria. Grazing animals with unrestricted access to streams can disturb the streambed aquatic habitat and contribute bacteria and nutrients directly to the channel flow.

Across the state there is an increase in urbanization and smaller ranches and hobby farms raising nontraditional livestock. These operations also have a potential to contribute to NPS pollution. The potential to impact water quality may be as great or greater from multiple small operations as from a single large livestock producer.

Improving riparian habitat, streambank stability, and channel condition through grazing BMPs is well-documented in the literature (Mosley et al. 1997). A strategy for reducing impacts of grazing on water quality and riparian and channel condition should include implementation of multiple BMPs prescribed on a site-specific basis, focusing on those areas especially susceptible to impacts from grazing, or contributing the largest pollutant loads. For any grazing management system to work, it must be tailored to fit the needs of the vegetation, terrain, and class or kind of livestock. For both pasture and range, areas should be provided for livestock watering, salting, and shade that are located away from streambanks and riparian zones. Proper grazing will maintain enough live vegetation and litter cover to protect the soil from erosion; will achieve riparian and other resource objectives and will also maintain or improve the quality, quantity, and age distribution of desirable vegetation. Low interest loans and cost-share grants are available from federal and state agencies to assist ranchers with off-site water design and installation, fencing, stream crossing hardening and other grazing related BMPs. Over the last thirty to forty years, the majority of livestock producers have implemented a variety of grazing systems, off stream water developments and improved riparian management (Jay Bodner, written message to DEQ, May 2007).

Proper Functioning Condition (PFC) is a qualitative method for assessing the condition of riparian-wetland areas developed and utilized for range management by the Bureau of Land Management (BLM), Fish and Wildlife Service (FWS), U.S. Forest Service, and Natural Resources Conservation Service. The term PFC is used to describe both the assessment process, and a defined, on the ground condition of a riparian-wetland area. In this approach, data are collected by an interdisciplinary team on hydrology, vegetation, and erosion/deposition attributes. From these monitoring data, the functionality of the riparian area is determined to be in proper functioning condition, non-functional (NF), or functional-at-risk (FAR). Determinations of causative factors of NF or FAR results are made in the field. Mitigation decisions are made to eliminate or reduce causative factors. Examples of mitigation include relocating a road away from an adjacent streamside, creating a riparian pasture, or installing a culvert. DEQ believes PFC can be an effective tool for riparian education, assessment, and local evaluation of the impacts of grazing management on riparian health.

State law provides for the creation of cooperative, nonprofit grazing districts and sets up a permitting system that aids in the management of grazing lands where ownership is intermingled, in order to conserve, protect, restore, and properly utilize grass, forage, and range resources. The Montana Grass Conservation Act, authorizes the Montana Grass Conservation Commission (administratively attached to DNRC), to advise, supervise, and coordinate these grazing districts. Management plans that conform to recognized conservation practices are developed by agencies and landowners for the use of lands within the boundaries of the districts. The 27 state grazing districts represent 1,353 permittees and cover 10,501,070 acres of land (DNRC 2005).

Montana's NPS pollution control strategy for pasture and range lands is summarized in **Table 4-4-2** below.

Table 4-4-2: Montana's Nonpoint Source Agricultural Strategy for Pasture and Range Lands	
Goal 6: Sustainable range land management will support the long term ecological health of grazing resources and meet water body beneficial uses.	
Objective 6.1 Support PFC, as a first tier assessment approach for riparian grazing management and monitoring, on private, state, and federal riparian areas in Montana.	
Actions:	
6.1a	Support land management agency (DNRC, BLM, USFS, and NRCS) utilization of PFC interdisciplinary functional assessments as a first tier approach of riparian grazing leases on federal and state public lands to assess and implement riparian grazing management strategies. Support site specific grazing BMPs (i.e. water developments, fencing, etc) and planned grazing systems which incorporates record keeping and monitoring.
6.1b	Support NRCS, USFS, and BLM PFC training workshops for conservation districts, irrigation districts and watershed groups throughout the state.
Objective 6.2: Support BMP implementation on all grazing and pasturelands.	
Actions:	
6.2a	Provide technical assistance and grants to private landowners to implement grazing BMPs as part of an approved Water Quality Plan.
6.2b	Focus BMP implementation on those lands that are contributing the most to water quality impairment.
6.2c	Promote the maintenance of existing native riparian areas and/or installation of vegetated filter strips composed of native woody vegetation along stream corridors on privately owned grazing lands.
6.2d	Work with DEQ's Technical and Financial Assistance Bureau and other agencies and organizations to develop, demonstrate, and publicize alternative stock watering systems (i.e. solar and wind) that support water quality restoration and protection.
6.2e	Support BMP implementation and education efforts of the Montana Range land Monitoring Program, DNRC Range land Resource Program, and other land management agencies.

Table 4-4-2: Montana's Nonpoint Source Agricultural Strategy for Pasture and Range Lands	
Goal 6: Sustainable range land management will support the long term ecological health of grazing resources and meet water body beneficial uses.	
Objective 6.3: Provide leadership for sustainable range management through effective application of BMPs on state and federal lands.	
Actions:	
6.3a	Work with DNRC to implement range assessments, and prescribed BMPs on state range lands.
6.3b	Protect and maintain existing natural riparian areas and/or install vegetated filter strips composed of native woody vegetation along stream corridors on state, USFS, and BLM grazing lands.

Note: The symbol denotes an education & outreach action

4.3.5 Animal Feeding Operations

Animal feeding operations (AFOs) can pose a number of risks to water quality and public health due to the amount of animal manure and wastewater they generate. To minimize water quality and public health impacts from AFOs and land applications of animal waste, the USDA and EPA released the Unified National Strategy for AFOs in 1999 (NRCS 2005). This strategy encourages owners of AFOs of any size or number of animals to voluntarily develop and implement site-specific Comprehensive Nutrient Management Plans (CNMPs) by 2009. This plan is a written document detailing manure storage and handling systems, surface runoff control measures, mortality management, chemical handling, manure application rates, schedules to meet crop nutrient needs, land management practices, and other options for manure disposal. An AFO that meets certain specified criteria is referred to as Concentrated Animal Feeding Operation (CAFO), and in addition may be required to obtain a Montana Pollution Discharge Elimination System (MPDES) permit as a point source.

Montana's AFO compliance strategy is based on federal law and has voluntary as well as regulatory components. If voluntary efforts can eliminate discharges to state waters, in some cases no direct regulation is necessary through a permit. Operators of AFOs may take advantage of effective, low cost, practices to reduce potential runoff to state waters, which additionally increase property values and operation productivity. Properly installed vegetative filter strips in conjunction with other practices to reduce waste loads and runoff volume are very effective at trapping and detaining sediment and reducing transport of nutrients and pathogens to surface waters, with removal rates approaching 90 percent (NRCS 2005). Other installations may include clean water diversions, roof gutters, berms, sediment traps, fencing, structures for temporary manure storage, shaping, and grading. Animal health and productivity also benefits when clean, alternative water sources are installed to prevent contamination of surface water. Studies have shown benefits in red meat and milk production of 10 to 20 percent by livestock and dairy animals when good quality drinking water is substituted for contaminated surface water.

Opportunities for financial and technical assistance in achieving voluntary AFO and CAFO compliance are available from conservation districts and NRCS field offices. Voluntary participation may aide in preventing a more rigid regulatory program from being implemented for Montana livestock operators in the future. Further information may be obtained from the DEQ website at: http://www.deq.mt.gov/wqinfo/mpdes/cafo.asp.

Montana's NPS pollution control strategy for AFOs is summarized in **Table 4-4-3** below.

Table 4-4-3: Montana's Nonpoint Source Agricultural Strategy for AFO/CAFO	
Goal 7: Support efforts to prevent nonpoint source pollution from AFOs.	
Objective 7.1 Prevent NPS pollution from AFOs.	
Actions:	
7.1a	Work with producers to prevent NPS pollution from AFOs.
7.1b	Promote use of State Revolving Fund for implementing AFO BMP's.
7.1c	Collaborate with MSU Extension Service, NRCS, and agriculture organizations in providing resources and training in whole farm planning to farmers, ranchers, conservation districts, watershed groups and other resource agencies.
7.1d	Encourage inspectors to refer farmers and ranchers with potential non point- source discharges to DEQ watershed protection staff for assistance with locating funding sources and grant opportunities for BMPs that meet their needs. (This is in addition to funds available through NRCS and the Farm Bill).
7.1e	Develop early intervention of education & outreach program for small farms and ranches that have potential to discharge non point-source pollutants from animal management activities. This includes assistance from DEQ internal (Permitting Division) as well as external entities (DNRC, local watershed groups, conservation districts, MSU Extension, etc.).

Note: The symbol denotes an education & outreach action

4.3.6 Forestry

There are 22.5 million acres of forestlands in Montana, nearly a quarter of the state's total land area. Montana's forests provide abundant and valued benefits, such as wood products, fish and wildlife, water, clean air, outdoor recreation, grazing, and natural beauty. The forest products industry employs approximately 9,700 workers. (Montana Wood Products Assn 2005) In 2004, the forest products industry contributed $970 million to the state's economy. The following chart shows the diversity of forest land ownership in Montana (**Figure 4-1**) and forest products production (**Figure 4-2**). Montana's largest forest land holder is the U.S. Forest Service, followed by non-industrial private land owners. The largest producer of forest products are industrial private lands, followed by non-industrial private lands (**Figure 4-2**). The forest lands of Montana are the headwaters for the state's important rivers and streams. These waters provide some of the west's best fishing as well as water for agriculture, recreation, public drinking water supplies, and many other uses.

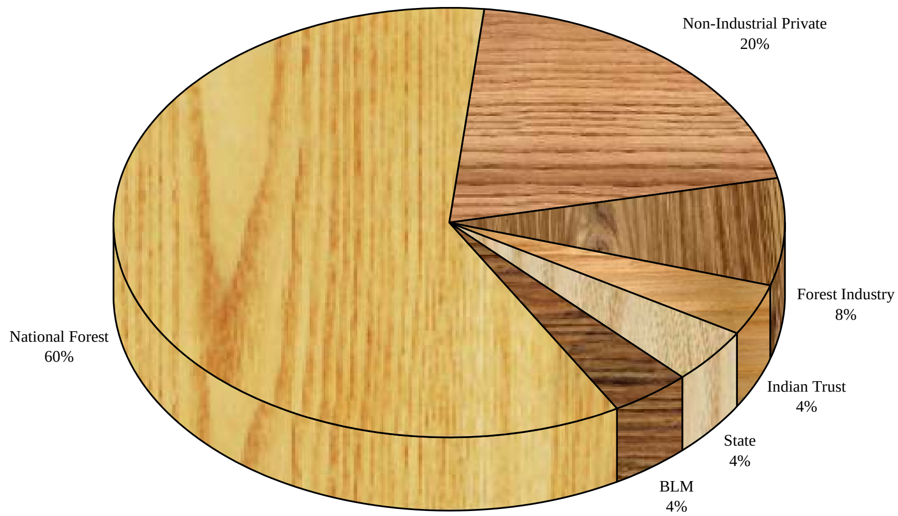


Figure 4-1: Forest Land Ownership in Montana in Year 2004 (Montana Wood Products Assn 2005)

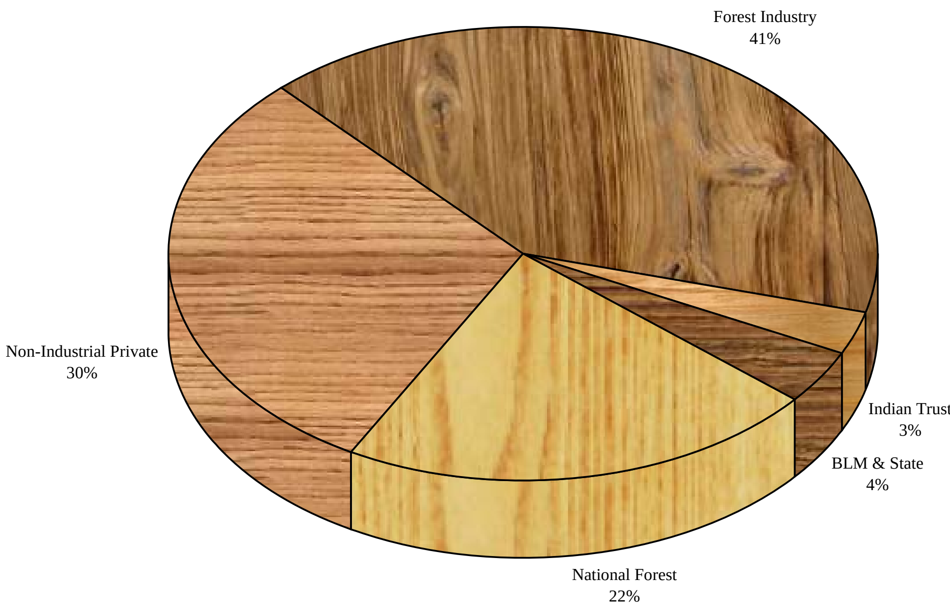


Figure 4-2: Forest Product Production in Montana (from Keegan and Morgan, 2005)

Montana has developed specific strategies for reducing NPS pollution resulting from forestry and forestry-related activities. Montana's nonpoint goal is to reduce water quality impacts associated with current and historic forest practices. Montana's water quality protection program for forestry and forestry-related activities relies on a combination of regulatory and voluntary approaches. The 1989 Montana legislature passed a law to provide forestry BMP information to private forest owners and operators to help protect water quality in Montana. This law also requires private forest owners/operators to notify the Forestry Division of the DNRC before conducting forest practices. Since that time, the forestry BMP Work Group has been reviewing and revising the original BMPs and providing statewide BMP audits on federal, state, and private forestry projects. Montana also has a Streamside Management Law (MCA 77-5-301 – 307), established in 1991, which provides regulatory standards for forest practices conducted around streams, lakes, or other bodies of water.

The primary forest activities that can cause water quality problems are discussed below, together with protective measures that can be taken to reduce NPS pollution.

Road Construction /Maintenance

Fine sediments in surface runoff from improperly located, designed, constructed, or inadequately maintained forest roads may enter stream channels. This sediment-laden runoff creates suspended or deposited sediments that impair drinking water uses, biological processes, and channel functions. Road related sediment, when added to natural background sediment loads, may overwhelm natural processes, changing stream morphology, biology, and other conditions. Sediment deposition may cause decreased channel function, shallow pool depths, increased channel widths, and poorly functioning pool habitat. These changes can result in increased water temperature and decreased biologic productivity. Poorly located, designed, constructed or maintained upland roads may cause chronic long term sediment delivery to streams. In some cases, diversion of surface runoff to streams can create new drainage patterns that quickly deliver storm waters to streams. These road caused diversions can result in establishment of newly eroding drainage networks. Water captured by these new networks would have been delivered to the stream system via shallow ground-water flow.

Watersheds with properly located, designed, and well maintained road systems (Sugden & Woods 2007) which also contain low to moderate numbers of stream crossings will normally have near natural rates of sediment production and provide high quality habitat for aquatic species (Gucinski, et al. 2001). Activities that minimize adverse water quality impacts from roads include locating roads out of riparian areas and away from streams, stabilizing all closed roads using effective drainage, limiting the number of stream crossings, closing/decommissioning poorly functioning roads that are not being maintained, and, proper road maintenance using BMPs. Other BMPs for reducing road sediment to streams include installing waterbars, drain dips, and ditch relief culverts, outsloping road surfaces, installing cross-drainage structures, replacing undersized culverts, aligning culverts for flood flows and fish passage, and protecting stream channels at vehicle fords.

Timber Harvest and Silviculture

Timber harvest, particularly within riparian/streamside areas, can affect streambank and floodplain integrity. Sufficient forest riparian vegetation slows surface water flows, while vegetative root systems inhibit erosion along stream banks. Riparian area vegetation acts as runoff buffers, filtering out sediments and nutrients. Removal of riparian trees and vegetation can affect stream temperatures by reducing the amount of streamside shade. Reduced streamside shading will adversely affect water temperatures and aquatic habitats. Removal of riparian vegetation can disturb ground cover and reduce nutrient cycling and aquatic food chains.

Montana’s Streamside Management Zone (SMZ) requirements are designed to protect SMZ functions.

Forest Strategies and Operating Guidance

A wide variety of land management strategies provide for protecting and enhancing water quality and maintaining aquatic species on forest lands. Forest land management plans for water quality and aquatic habitat include federal forest management plans, state forest plans, state and private habitat conservation plans, local growth management plans, family forest stewardship tree farm plans, and local watershed plans. These forest and water quality plans include:

- BMPs for Forestry in Montana, January 2004 (MT DNRC, 2004).
- Montana Streamside Management Act (MCA 77-5-301 and ARM 36.11.301).
- MOU and Conservation Agreement for Westslope Cutthroat Trout in Montana (MT FWP 1999).
- Native Fish Habitat Conservation Plan by Plum Creek Timber Co. (2000). (http://www.fws.gov/idahoes/PlumCr/NFHCP.htm).
- INFISH - Inland Native Fish Strategy (Wright 1995).
- Forest Service Handbook 2059.22 Soil Water Conservation (US Forest Service, 2007).

Montana's water quality programs for forest lands rely primarily on a voluntary forest practices approach (forestry BMPs), backed by a statewide forest Streamside Management Zone (SMZ) requirement. In 1989, Montana’s first statewide forestry BMPs were adopted. Forestry BMPs were developed in a cooperative process involving professional foresters. These forest practices are updated biannually by the DNRC Forestry Assistance Bureau, UM School of Forestry hydrologists, UM staff, conservationists, state and federal agencies, and industry (see **Appendix A** for Year 2004 Forestry BMPs). These voluntary forest practices are described and illustrated in a Forestry BMP handbook. Key forestry BMPs include:

- Streamside Management Zones
- Road planning, design, drainage, construction and maintenance
- Forest harvest design, and slash treatment
- Stream crossing requirements, design, channel crossing
- Winter construction, harvest and erosion control

Forestry BMP and SMZ training is provided in biannual workshops, and is promoted at forest industry meetings and conferences. In 1989, Montana began requiring all landowners planning to harvest timber to notify the DNRC Forestry Division before starting harvest activities. The Forestry Division sends BMP information to the landowner.

Forest practices audits are conducted by an interdisciplinary team with representatives from private, industry, conservation group, state, and federal personnel reviewing recent harvest activities by all participating landowners. Most forestry impacts result from road construction, maintenance, and drainage. The audit teams have examined the application of forest practices across four ownership types (state, federal, industrial, and non-industrial private landowner) and found only a few percentage points difference in BMP application and performance, indicating that BMPs are applied consistently across ownership types.

Since 1990, these biennial audits have assessed the application and effectiveness of BMPs. These forestry audits show considerable progress in BMP application over the past decade (see **Table 4-5**). The year 2006 audits found that forestry BMPs were correctly applied 96 percent of the time.

Table 4-5: Trends in Montana Forestry Best Management Practices Audit Results – Years 1990-2006 (MT DNRC 2006)

	2006	2004	2002	2000	1998	1996	1994	1992	1990
Application of practices that meet or exceed BMP requirements	96%	97%	96%	96%	94%	92%	91%	87%	78%
Application of high risk practices that meet or exceed BMP requirements	89%	89%	90%	92%	84%	81%	79%	72%	53%
Percentage of sites with at least one major departure in BMP application.	9%	13%	23%	9%	17%	27%	37%	43%	61%
Average number of departures in BMP application, per site.	1.5	1.3	1.8	1.4	2	3	3.9	5.6	9
Percentage of practices providing adequate protection.	97%	99%	97%	98%	96%	94%	93%	90%	80%
Percentage of high risk practices providing adequate protection	92%	95%	92%	93%	89%	86%	83%	77%	58%
Percentage of sites having at least major/ temporary or minor/prolonged effectiveness departure.	16%	25%	35%	21%	26%	34%	28%	37%	64%

The SMZ law enacted in 1991 regulates private, many USFS, BLM but not Tribes forest management activities along streams and isolated wetland areas. Since 1994, the BMP audits have evaluated compliance with SMZ requirements as well as with the voluntary forest BMPs. The year 2006 audits (MT DNRC 2006) found SMZ requirements were correctly applied 98% of the time. SMZ effectiveness was rated very high (99 percent). Plum Creek Timber Company, Montana's largest private forest industry landowner, entered into a Habitat Conservation Plan (HCP) with the U.S. Fish and Wildlife Service in November, 2000. The HCP agreement, which covers 1.3 million forested acres in western Montana, specifies forest/riparian habitat policies and standards to conserve five native fish species (including bull trout), which are currently listed as threatened under the Endangered Species Act.. All of the Plum Creek Timber Company's land management activities that may affect fish habitat, including timber harvesting, road building, and land sales are governed by this plan. This plan includes road BMP effectiveness monitoring, riparian and canopy cover measurements, temperature effects, and grazing riparian condition measures and monitoring (Plum Creek Native Fish Habitat Conservation Plan, Appendix AM-1 2000). Under this plan, Plum Creek is upgrading all old roads to current BMP standards by year 2016 with high priority watersheds being completed by year 2011.

Another source of watershed sediments is increased runoff from watersheds affected by large fires (post-fire runoff). The federal interagency Burned Area Emergency Response (BAER) program assesses and prescribes restoration treatments designed to protect life, property, and ecosystem function. This program can access federal and adjacent lands to downstream locations where the runoff risks of the fires are notable. The Natural Resources Conservation Service both participates in interagency BAER planning efforts and provides direct assistance to private land owners through the Emergency Watershed Protection (EWP) program. Post-fire soil and water restoration practices are prescribed on a case-by-case basis. Monitoring continues to improve understanding of the effectiveness of these post-fire practices.

In the development of WQPs and TMDLs, DEQ develops allocations for all significant nonpoint, forestry-generated sources of pollution. The Water Quality Plans also provide implementation and monitoring strategies to encourage restoration of beneficial uses and tracking progress towards that goal.

Montana's forestry NPS pollution control strategy is summarized in **Table 4-6** below.

Table 4-6: Montana's Nonpoint Source Forestry Strategy

Goal 8: Forestry best management practices (BMPs) are utilized to consistently achieve water quality standards, with monitoring showing that waters with current forest activities fully support their beneficial uses.	
Objective 8.1: Support ongoing effectiveness of forestry BMP and SMZ audit programs.	
Actions:	
8.1a	Work with forestry partners (especially DNRC Forestry) to ensure forestry BMP and SMZ activities are effectively practiced.
8.1b	Work with federal, state and local agencies and forestry associations to insure SMZ buffers are effective in achieving and maintaining water quality standards.
8.1c	Cooperatively develop a summary of cumulative watershed-level improvements (overall in-stream water conditions) resulting from multiple applications of forestry BMPs and other watershed restoration measures.
8.1d	Develop and support education and outreach activities targeted for road construction/maintenance operator trainings.
8.1e	Assess the cumulative success of SMZs in achieving watershed level water quality standards..
Objective 8.2: For forested lands, cooperatively identity highly effective (key) Forestry BMPs and develop guidelines for key BMPs which achieve water quality standards.	
Actions:	
8.2a	Work with resource partners (especially DNRC Forestry and MSU Forestry Extension) to assess the effectiveness of forestry and forest grazing BMPs (and watershed activities) in moving toward overall watershed water quality standards.
8.2b	Work with resource partners (especially DNRC Forestry and the Burned Area Emergency Rehabilitation Team) to assemble information on effective post-fire soil and water BMPs for post-fire rehabilitation projects.
8.2c	Cooperatively work with land management agencies (USFS, BLM, DNRC, FWP, etc.) on land management planning standards, road management and operations, TMDLs, prioritization of sensitive/crucial watersheds, and other cooperative practices to achieve water quality standards within 10 years using memorandums of understanding (MOUs) or similar cooperative agreements.
8.2d	Compile BMPs for post-fire rehabilitation and make available to private forest landowners so that they gain an understanding of fire function in ecosystems.

Note: The symbol denotes an education & outreach action

Historical Forest Practices Restoration

A wide variety of historical forestry practices have caused increased sediment and temperatures in Montana waters. Poorly designed/excessive historic roads and past removal of stream-side vegetation are two primary sources of water quality degradation from past forestry activities. Forest roads can produce long-term chronic sediment runoff and are generally considered the most significant forest management-related impact to water quality (Plum Creek Native Fish Habitat Conservation Plan, 2000). Complete tree removal along streams was once routinely conducted, which elevated stream-side erosion and exaggerated water temperatures. This harmful practice has been precluded by state law since 1991, and the amount of new stream-side forest clearing has dropped to near zero. Statewide biennial water quality assessments have identified a substantial number of Montana streams (231 waters currently) as water quality impaired from a variety of past forest activities, including silviculture and forest roads (see **Table 4-7**). The largest source of impaired forest waters have been caused by past forestry activities (particularly forest removals along stream sides) and forest roads. Less than five percent (8 waters) of the forestry-related impaired waters are also impaired by thermal factors (excessive temperatures).

Table 4-7: Waters with Forestry Related Water Quality Impairments

(number of water bodies having forestry related impairments) – from Montana ADB and 303(d) Reports

Sources:	Year 1996	Year 2006
Forestry, harvesting & silviculture	225	133
Logging & forestry roads	33	98
Total -Forest Related Sources	**258**	**231**

Widely accepted agreement on design guides for restored road stream crossings and culverts is a necessary first step in achieving restoration goals. Montana forest practices presently require that culvert or other stream crossings must pass a 25 year runoff event. However, many new forest roads are normally designed to pass 50 or 100 year or larger flood flows, as it is recognized that culverts in sensitive watersheds need to be able to pass larger storm flows and associated forest-related debris. Presently, there are no accepted statewide design standards for restoring undersized culverts or other stream crossing structures. Montana DNRC has organized a fish passage sub committee of the BMP working group to better insure that culverts will allow for fish passage. These culvert passage design factors were field tested during the year 2006 forestry audits to better determine if fish passage can be assessed by the audit teams as part of the established protocol. These audits should also give indications of the percentage of culverts where fish passage may be blocked. This additional information may result in new culvert sizing guidance or requirements.

A variety of watershed group, agency, and private land-owner watershed assessments have identified streams and channels that are “partial functioning” or “functional – at risk”. These assessments provide data to begin delineating the amount and scope of future forestry watershed restoration. Recent interdisciplinary U.S.F.S. reviews have identified watersheds that are high priority for watershed restoration activities. Watershed restoration activities typically include reducing the impacts of road crossings on streams, reducing sediment delivery from roads to streams, and improving riparian woody vegetation functioning.

Recently completed TMDL Plans that identify a variety of forest restoration activities include *Water Quality Assessment and TMDL for Flathead River Headwaters Planning Area, December, 2004, Grave Creek Watershed Water Quality and Habitat Restoration Plan and Sediment TMDLs, March 2005,* and *Water Quality Plan and TMDL for the Bobtail Creek Watershed, January 2005*. For the list of completed TMDLs through 2006 see **Appendix G**.

Montana's NPS pollution control goals and strategy for forestry restoration is summarized in **Table 4-6-1.**

Table 4-6-1: Montana's Nonpoint Source Forestry Strategy for Historical Forestry Impacts Restoration	
Goal 9: Watershed and forest/riparian plans are implemented to restore forest watersheds and waters to support beneficial uses by year 2017.	
Objective 9.1: Cooperatively develop widely accepted design standards (reasonable land, soil and water conservation practices) for restoring forest roads, water yields, and road runoff to achieve beneficial use support.	
Actions:	
9.1a	Work with state agencies (DNRC and FWP), the forest BMPs working group, the fish passage sub committee of the forest BMP working group, forest landowners and watershed groups to identify/prioritize watershed restoration activities, including reasonable land, soil and water conservation measures (restoration practices) for Montana regions having substantial water quality degradation from forest activities/roads, and to identify/prioritize major watershed legacy forest impacts.
9.1b	The land management agencies (USFS, BLM, DNRC, FWP, etc.) and DEQ will develop new interagency agreements (which may include a MOU) to restore water quality on public lands and related goals. The agreement will be designed to foster cooperation that will result in greater efficiency and quicker restoration of impaired (303(d) listed) waters.
9.1c	As part of every watershed planning process, encourage private forest landowners to develop forestry management plans incorporating water quality protections (BMPs) and restoration of historic forestry impacts (restoration practices).
9.1d	Work with DNRC Forestry to include water quality BMPs for outreach materials to target private forest landowners in Swan, Flathead, Bitteroot, Gallatin, and surrounding Missoula Valleys. Include impacts to forests to include SMZs, roads, and burned areas to educate landowners.
9.1e	Work with resource partners (DNRC Forestry, MSU Forestry Extension, MDT, and Western Transportation Institute) to conduct cooperative trainings for restoration of road crossings, design for proper drainage of roads, culvert replacement/removals, effective maintenance in riparian areas and effective long-term road maintenance for increased water quality.

Table 4-6-1: Montana’s Nonpoint Source Forestry Strategy for Historical Forestry Impacts Restoration	
Goal 9: Watershed and forest/riparian plans are implemented to restore forest watersheds and waters to support beneficial uses by year 2017.	
Objective 9.2: Work with federal and state land management agencies to establish timelines to achieve state water quality standards on their forested lands, including watershed restoration targets and progress schedules in land and forest management plans.	
Actions:	
9.2a	Implement projects that will substantially achieve water quality standards for beneficial uses in waters on federal and state lands within 5 years of an approved Watershed/TMDL Plan or forest management plan. This process may include restoration goal progress indicators for Class II and III waters within federal land and forest management plans.
9.2b	Develop cooperative agency guidance for restoring/retaining appropriate temperature and sediment transport on streams on federal and state lands relating to off-stream diversion.
9.2c	Develop a targeted process for smaller watersheds (three forested 12th digit HUCs) toward supporting water quality standards for all waters affected by forest uses for the Kootenai, Flathead, lower Clark Fork, Bitterroot, upper Clark Fork, upper Missouri, Missouri-Sun-Smith, Marias, upper Yellowstone, and Musselshell-Middle Missouri sub-basins by year 2012.

Note: The symbol denotes an education & outreach action

4.3.7 Diffuse Urban and Suburban Pollution

Diffuse pollution from urban and suburban sources is generated by a broad range of activities associated with domestic, municipal, industrial, and commercial land development and land uses. Mitigation of urban and suburban pollution sources presents challenges because once structures are in place, they may be there permanently and/or they may have long-lasting impacts on water resources.

Storm water runoff, construction, stream channelization, waste disposal, road sanding, and daily household activities may be potential sources of NPS pollution that affect water resources. Fertilizers, pet wastes, leaves, grass clippings, and faulty septic tanks can contribute to nutrient and bacterial pollution. Improperly handled chemicals, paints, solvents, detergents, antifreeze, and pesticides may also enter waterways. Landfills, particularly unlined facilities, pose a threat to surface and ground-water quality because harmful and toxic substances may leach into aquifers or surface waters. Roads can be a source of petroleum hydrocarbons and heavy metals from diesel and gasoline vehicle usage and even road maintenance activities like sanding and roadside vegetation management can contribute sediment, pesticides, and nutrients to adjacent waterways.

Growth and development in Montana are not evenly distributed across the landscape. Historical settlement patterns often followed major waterways, with local economies largely driven by the presence of natural resources. With the advent of new technologies and the national trend towards a service based, mobile economy, population and development have concentrated primarily in western Montana. Census results from 1990 to 2000 indicate that overall the state grew by 13 percent, but counties like Gallatin and Ravalli had growth rates of 30 percent or more while many eastern Montana counties like Custer and Phillips saw stagnant or declining population growth rates. New subdivision applications data from 1990 to 2006 collected by the DEQ's Subdivision Review Program virtually mirror the census figures. DEQ's subdivision data show that the number of applications reviewed over the last sixteen years has remained fairly consistent but the numbers of lots per subdivision are increasing (**Figure 4-3**). These growth and development patterns suggest that many potential contaminants are in close proximity to the state's water resources and underscore the need for local involvement in watershed planning and NPS pollution prevention and awareness.

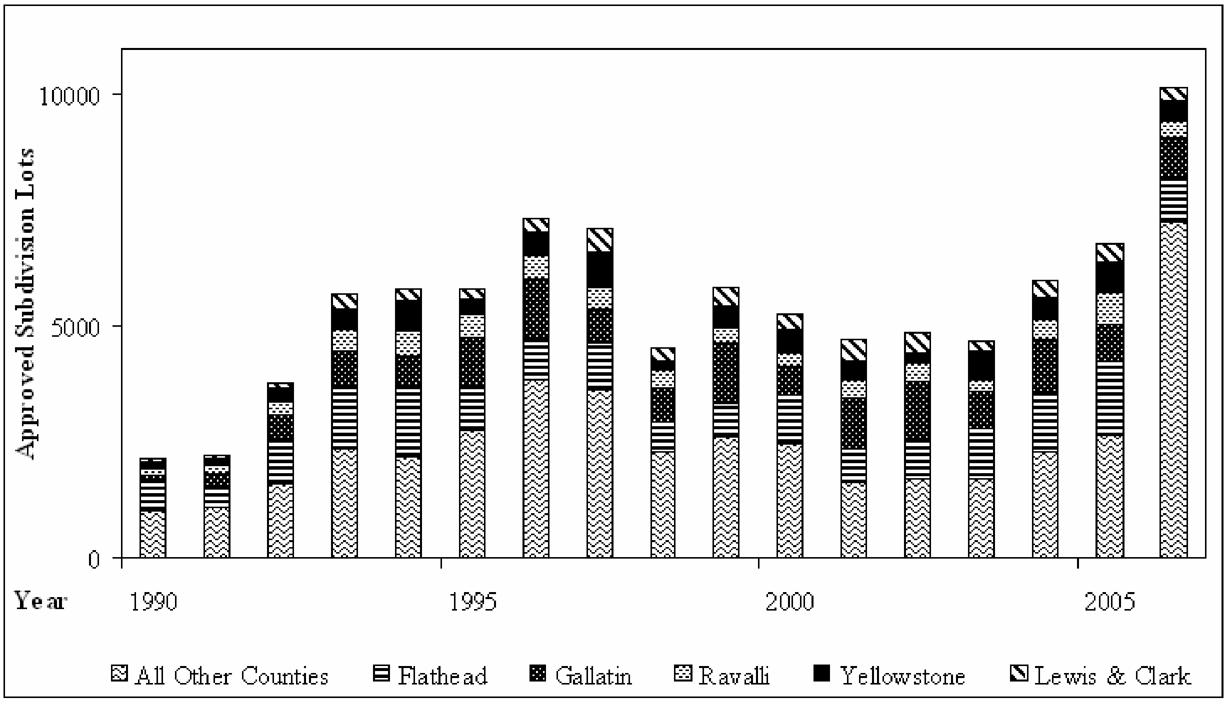


Figure 4-3: DEQ Subdivision Lots Approved in 1990-2006 *
*Showing the portion of approved lots within the five counties with the highest average number of lot approvals.

4.3.7.1 Major Sources of Diffuse Urban and Suburban Pollution

Pollutants of concern and water quality impacts from urban and suburban sources are discussed in more detail in the following sections, together with NPS control mechanisms.

Storm Water Runoff

Buildings and infrastructure such as roads, sidewalks, and driveways generally have impervious surfaces that prevent water from soaking into the ground and as a result generate storm water runoff. Urban and construction storm water runoff are leading sources of NPS pollution. Nationwide, these sources account for 13 percent of water quality impairment (EPA 2005). In Montana, storm water runoff related to permitted and non-permitted activities represents about 1 percent (DEQ 2006) of all impaired stream miles in Montana.

Storm water runoff may carry high levels of pollutants such as sediment, nutrients, oxygen demanding substances, road salts, heavy metals, petroleum hydrocarbons, pesticides, pathogenic bacteria, and viruses. The type and concentration of pollutants in storm water runoff is highly variable. The frequency and intensity of rain affects the amount of pollutants collected in overland flow, the distance pollutants are transported, and the level of sediment deposition and suspension. Impervious surfaces (streets, driveways, parking lots, sidewalks, roofs, etc.) act as collectors and conduits for pollutants from concentrated human activities until storm water runoff picks them up and discharges them untreated to waterways via storm sewer systems. When left uncontrolled, these discharges can threaten public health, kill fish, destroy spawning and aquatic habitat, and contaminate drinking water supplies.

Construction

Suspended sediments constitute the largest pollutant loads to receiving waters in urban areas, with construction a leading cause of erosion. Typically, sediment runoff rates from construction sites are 10-20 times greater than those from agricultural lands and 1,000 to 2,000 times greater than those of forestlands. During a short period of time, construction activity can contribute more sediment to streams than is naturally deposited over several decades.

In addition to direct water quality impacts, construction and associated land development often changes the hydrology and geomorphology of receiving waters, with potentially adverse effects to aquatic and riparian habitat. Development reduces vegetative cover and increases the area covered by impervious surfaces, thus eliminating the natural water retention provided by plants and soils and reducing recharge to ground water. As the area of impervious surfaces increases, the volume and intensity of runoff during rain events increases (**Figure 4-4**). The resulting stream flows can lead to channel widening, erosion, decreased channel stability, stream temperature increases, and sediment suspension and deposition. Over time, these effects, as well as pollutant contributions, may adversely impact aquatic life and water quality and restrict recreational activity. Studies around the country have shown that when as little as eight to twelve percent of a watershed surface consists of impervious surfaces, aquatic life is adversely impacted (EPA 2005b).

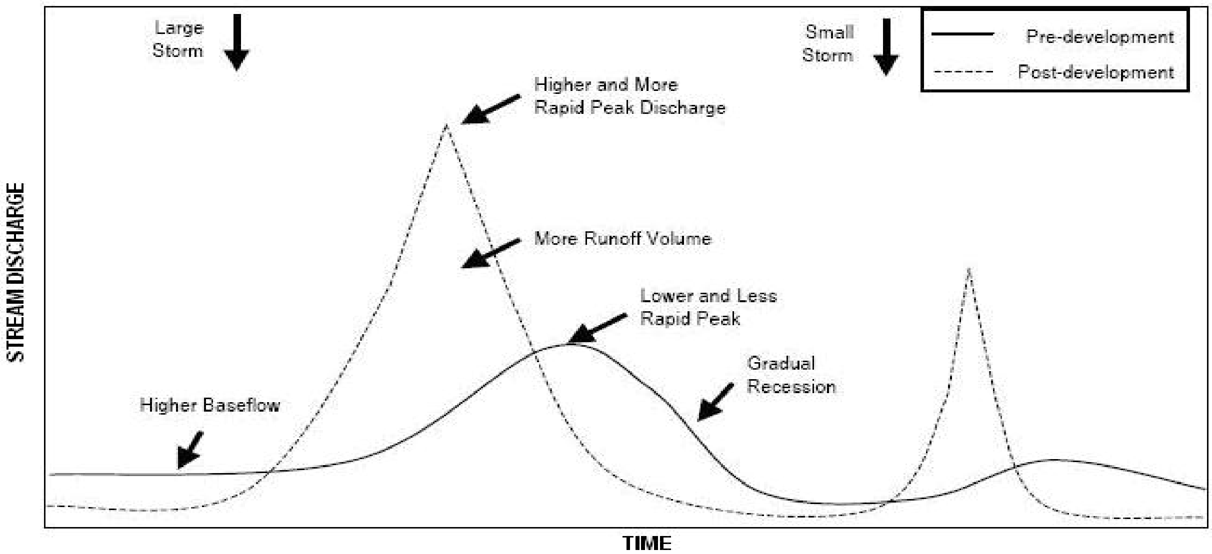


Figure 4-4: Changes in Streamflow Hydrograph as a Result of Urbanization*
*Used with permission from *National Management Measures to Control Nonpoint Source Pollution from Urban Areas*. 2005. U.S. Environmental Protection Agency Circular EPA-841-B-05-004, page 0-23.

Waste Disposal

In the United States, septic systems make the largest contribution of wastewater to soils and ground water and have been linked to water quality degradation. These systems are also referred to as onsite subsurface wastewater treatment systems and are addressed in DEQ Circular 4 (DEQ 2004a). Most family homes and businesses developing outside of incorporated areas in Montana rely on septic systems for on-site wastewater treatment and disposal. The 2005 U.S. Census estimated that 65 percent of the state's population is rural. Although a portion of these rural residents are probably served by centralized wastewater treatment facilities, it is likely that a majority of this population contributes waste to septic systems.

A properly functioning septic system can treat and in some cases totally remove contaminants from wastewater, but many optimum conditions must be met to avoid the release of excess pollutants to ground water and ultimately to surface water. Common pollutants of concern include nutrients (nitrogen and phosphorus), pathogens (bacteria, parasites, and viruses), household chemicals, and personal care products (pharmaceuticals and endocrine disrupters). Under conventional designs, even a properly functioning septic system will release fairly high amounts of nitrogen in the form of nitrate with estimates ranging from 30 to 90 mg/L nitrate after percolation (Tri-State Water Quality Council 2005). Current state subdivision regulations for septic systems seek to protect human health by enforcing minimum lot sizes, well and septic placement, and maintaining ground-water nitrate concentrations below 10 mg/L, the human health limit. However, the effect of septic systems on surface waters are rarely evaluated, which can be cause for concern considering that natural background nitrate concentrations in surface waters are generally at least an order of magnitude or more below the human health standard for drinking water.

The cumulative impacts of septic systems are a significant water quality concern in the rapidly developing suburban areas of Montana. For instance, in the Missoula Valley, impacts from septic systems have been documented as affecting ground-water quality and nutrient concentrations in the Clark Fork and Bitterroot rivers (Tri-State Water Quality Council 2005). As mentioned previously, a recent study in the Helena Valley detected pharmaceutical compounds in 80 percent of the wells that were sampled and concluded that domestic wastewater is likely degrading ground-water quality there (Miller and Meek 2006). Local water quality districts have formed in the Missoula, Gallatin, and Helena areas and are working to address this and other local water resource issues **(See Appendix B for a full listing)**.

Estimates of septic system failure rates in the United States range from 5 to 25 percent and higher (EPA 2005a). Accordingly, periodic maintenance and inspection are crucial for preventing septic system failure. In Montana, there are no specific enforcement programs in place to regulate the maintenance and operation of private individual septic systems. Property owners need to be aware of proper maintenance techniques. The DEQ, county health departments and extension agents, and local water quality districts are available to provide assistance. DEQ's Circular 4 provides information on Montana standards for design and citing of subsurface wastewater treatment systems (DEQ 2004a). An MSU Cooperative Extension Service publication, 'Septic Tank and Drainfield Operation and Maintenance', is an excellent primer for septic system owners: http://www.montana.edu/wwwpb/pubs/mt9401.html (Vogel 2005).

Solid wastes are also a concern for water quality and often contain hazardous substances such as carcinogens in addition to more common pollutants (e.g. sediment, nutrients, and metals). Ground-water quality may be more likely to experience degradation from the leaching of solid wastes. Thirty years ago there were more than 500 landfills and waste dumps in Montana. Most of these have been closed. As of 2007 there are 108 licensed solid waste facilities. Twenty-seven active and thirteen inactive waste management facilities are monitored for ground-water quality impacts. Closed landfills that do not require monitoring for water quality impacts may be a concern for nonpoint source pollution.

Land applied biosolids from waste water in treatment plants and septic tanks, petroleum contaminated soils, and materials placed in licensed municipal landfills, and construction and demolition waste landfills are regulated by the DEQ's Solid Waste Management Program. Licensed solid waste sites are subject to technical reviews, certifications, and compliance monitoring. DEQ also provides technical assistance to solid waste professionals.

Roads

The transportation system within the state contributes to NPS pollution through storm water runoff, construction, and maintenance activities, flood plain encroachment, and atmospheric deposition. According to Montana's 2006 Integrated Report, approximately 34 percent of the listings for streams and rivers and about three percent of the listings for lakes, reservoirs, and wetlands have a road related source (i.e. channelization, construction/non-construction related, accidental spills, etc.).

Vehicles release pollutants such as oil and grease, particulate matter, and heavy metals (i.e. brake pad asbestos) that can be picked up by storm water runoff and delivered to state waters. In addition to runoff concerns, road construction may result in flow constriction at road crossings (culverts, bridges), soil erosion, and head-cutting which increase sediment loads and may also contribute to in-stream and riparian habitat alterations. Maintenance activities such as roadside vegetation management and road sanding can unintentionally send pesticides, sediment, and chlorides (traction and de-icing chemicals) to water bodies. A recent study completed by the MDT found that most of the traction material that is side cast from the road lands within 20 feet of the plowed edge and that speed of the plow has little effect on the distance the material is thrown (Stimson 2005). Vehicle exhaust (nitrous oxides, particulates, lead, etc.) contributes to air pollution which can affect water quality through atmospheric deposition.

The MDT conducts research, training, and projects to address environmental impacts from roads. The Local Technical Assistance Program (LTAP) assists the MDT and the Federal Highway Administration with transportation “training, technical assistance, and technology transfer” (http://www.coe.montana.edu/ltap/index.html). Another organization, the Western Transportation Institute (WTI), provides MDT with “high quality research that leads to a demonstration of solutions” (http://www.coe.montana.edu/wti/). New research developments pertaining to water quality include the formation of the Interagency Review Team Working Group (IRTWG, WTI facilitates), which is piloting an integrated approach to transportation planning (Integrated Transportation and Ecosystem Enhancements for Montana [ITEEM]) for Highway 83. Use of the ITEEM approach for other highway projects is desirable so that projects are assessed in the broader context of ecosystem and watershed resources.

4.3.7.2 Diffuse Urban and Suburban Pollution Control Measures

Diffuse urban and suburban NPS pollution may be addressed through public education and involvement; enforcement of illicit discharge regulations; and effective state and local management of NPS water quality from industrial activity, construction sites, and new and existing development and infrastructure.

Water Pollution Discharge Permits

An MPDES permit or a Montana Ground Water Pollution Control System (MGWPCS) permit from the DEQ is typically required to construct, modify, or operate a disposal system or to construct or use any outlet for discharge of sewage, industrial, or other wastes into state surface or ground water. All point sources of wastewater discharge are required to obtain and comply with their discharge permits. The effluent limitations and other conditions contained in DEQ’s discharge permits are based upon preservation of Montana’s water quality standards. Each discharge permit issued is designed to protect the receiving water’s quality at the point of discharge.

There are four types of general storm water MPDES permits that apply to runoff: industrial, construction, mining and extraction (oil and gas), and municipal separate storm sewer systems (MS4s). Storm water discharges may be permitted under a separate individual MPDES permit (facility specific) or permitted under the general MPDES permits listed above (geographic region

or statewide). More information on water discharge permits can be obtained at the following DEQ websites:
http://www.deq.mt.gov/wqinfo/WaterDischarge/Index.asp
http://www.deq.mt.gov/wqinfo/MPDES/PermitTypes.asp

In December of 1999, the EPA published Phase II Final Rules for storm water. These rules extended MPDES permit requirements to certain regulated small municipal separate storm sewer systems (MS4s) and to construction activities disturbing between 1 and 5 acres of land. The small MS4 designation applies to Montana's seven largest cities, three counties, the Montana Department of Transportation, Montana State University (Bozeman), University of Montana (Missoula), and Malmstrom Air Force Base. The MPDES general MS4 permit requires that a Storm Water Management Program (SWMP) be developed, implemented, and enforced such that certain minimum control measures are addressed through BMPs and evaluated with measurable goals. An SWMP must include the following six minimum control measures:

1. Public education and outreach
2. Public participation/involvement
3. Illicit discharge detection and elimination
4. Construction site runoff control
5. Post-construction runoff control
6. Pollution prevention/good housekeeping

More information and examples of the SWMP requirements can be found in the EPA's 'National Menu of Storm Water BMPs: http://cfpub.epa.gov/npdes/storm water/menuofbmps/index.cfm.

Similar to a SWMP, many of the MPDES storm water permits require the development of a Storm Water Pollution Prevention Plan (SWPP). An SWPP identifies potential sources of pollutants and BMPs to minimize or eliminate pollutants in storm water runoff from a permitted facility or activity. The DEQ determines the specific requirements and information to be included in a SWPPP based on the type and characteristics of a facility or activity and on the respective MPDES permit requirements.

Development and Innovation Concepts

Planning for urban and suburban growth and development is essential for the management of storm water runoff and the protection of water quality in higher population density areas. Planning to protect sensitive areas, like wetlands and riparian areas, and incorporating technologies that infiltrate storm water runoff and filter pollution will assist in the preservation of water quality. Improvements in water quality may also result when 'retrofit' designs or practices are applied to existing structures. An example of a retrofit design to benefit water quality is replacing concrete medians with vegetated swales, while an example of a retrofit practice is instituting a recycling program not already in practice.

Land use planning that incorporates 'smart growth' principles can assist in preventing NPS pollution from urban and suburban sources. Smart growth is not a rigid design, but rather a template of sustainability principles that can be employed during the land use planning process. The idea of sustainable land use practices promoted by smart growth applies to the protection of water quality. The federal government, through the efforts of the Environmental Protection

Agency promotes the use of smart growth principles for environmental protection, because "development guided by smart growth principles can minimize air and water pollution, encourage brownfields clean-up and reuse, and preserve natural lands" (http://www.epa.gov/smartgrowth/index.htm).

Whether or not land use planning follows smart growth guidelines, effective land use planning for the protection of water quality must be supported by an objectively informed local citizenry and governing entities. Land use planning is governed at the state level under Title 76 of the Montana Code Annotated. In the rapidly developing areas of the state, many cities and counties are planning to meet the needs of future growth, but are finding that current practices are not sufficient for attaining water quality standards. Management of solid waste, waste water from treatment facilities and individual septic systems, storm water runoff, and other infrastructure needs, such as roads, sidewalks, and utilities may require substantial investments to come into compliance with regulatory water quality programs, such as TMDL waste load allocations and Phase II storm water regulations. This is a challenging situation that will require creative solutions on the part of the regulators, the regulated, as well as the unregulated. In addition to individual city and county planning mandates, Montana has numerous organizations that assist with formalized land use planning efforts.

Riparian Buffer/Setback Ordinances

As part of the land use planning process, many Montana county and city governments have developed buffer/setback regulations and zoning laws to protect stream and river corridors, floodplains, lakeshores, and wetlands for aesthetic, economic, and wildlife values (**Appendix A**). The degree to which these buffers are planned, designed, and maintained determines the benefits they are able to provide. Buffer zones adjacent to surface water bodies provide a transition area between upland land uses and the water body. Setback ordinances, as used in the context of this Plan, are a regulatory mechanism that provide specified buffers for water quality protection and have primarily focused on urban and suburban land uses.

Numerous studies have demonstrated the effectiveness of buffers for protecting water quality. Forested buffers have been shown to remove 50 percent suspended sediment, 23 percent to 96 percent phosphorus, greater than 40 percent lead, 60 percent copper, zinc, aluminum and iron, and more than 70 percent oil and grease (EPA 2005b). Vegetated filter strips have been shown to reduce total phosphorus by 75 percent, total nitrogen by 70 percent and sediment by 65 percent (EPA 2003a). As discussed earlier, there are many well documented economic benefits of wetlands and riparian buffers, in addition to NPS abatement, including increased property values, public green space for recreation, flood control, reduced soil loss, and wildlife values. In Kansas for example, $600,000 was spent to restore streamside greenways to provide storm water control, saving $120 million on the alternative engineered storm water control projects that would have been implemented (EPA 2005a).

For optimal storm water treatment, the buffer should be composed of three lateral zones: a storm water depression area that leads to a grass filter strip that in turn leads to a forested buffer. The storm water depression is designed to capture and store storm water during smaller storm events, and bypass larger storm flows directly into a channel. The captured runoff within the storm water depression can then be spread across a grass filter designed to allow sheet flow. The grass filter then discharges into a wider forest buffer designed to have zero discharge of surface runoff to the stream (i.e. full infiltration of sheet flow). Proper design and maintenance of buffers can help increase the pollutant removal from storm water runoff.

Urban and suburban buffers typically range from 20 to 200 feet and should include the 100-year floodplain, riparian areas including adjacent wetlands, steep slopes, or critical habitat areas. A buffer at least 100 feet wide is recommended for water quality protection and a 300 foot buffer is recommended to maintain a wildlife habitat corridor (EPA 2005a). Wider buffers increase detention time, infiltration rate, and diversity of soil, vegetation, and wildlife. Minimum widths for buffers should be 50 feet for low order headwater streams, with expansion to as much as 200 feet or more for larger streams (EPA 2005a).

An example of a numeric buffer/setback for water quality protection in urban and suburban environments follows:

1. 100 feet, including the 100-year floodplain, riparian areas and adjacent wetlands. The buffer should always incorporate the 100-year floodplain even if it is wider than 100 feet.
2. Add 2 feet per 1% slope.
3. Subtract for existing impervious surfaces in the riparian zone. They do not count toward buffer width (i.e., the width of the buffer is extended by the width of the impervious surface, just as for wetlands).
4. This starting point can be refined to include wildlife, economic, or visual goals requiring wider buffers using the Planning Guide for Protecting Montana’s Wetland and Riparian Areas (Montana Watercourse, July 2003).

Buffer ordinances should also include buffer boundaries clearly marked on local planning maps, maintenance language that restricts vegetation and soil disturbance, tables that illustrate buffer width adjustment by percent slope and type of stream, and direction on allowable uses and public education. Zoning laws are currently the most protective form of regulation being used by counties. Montana DEQ administers setback regulations for wells and septic drain fields (MCA 17.36.323) and requires a 100 foot minimum setback distance between wells and septic systems and adjacent surface waters (seasonal high water mark), springs, and floodplains.

An example of the riparian setback requirements adopted in Lewis and Clark County are shown in **Table 4-8** below.

Table 4-8: Example: Riparian Setback/Buffers from Lewis and Clark County, MT

County	Type of Regulation	Size or setback or other Standard		Area Protected
Lewis and Clark County	Subdivision Regulations	Setbacks Type I - 250 ft Type II - 200 ft Type III - 100 ft Type IV - 50 ft	Buffers 100 ft 75 ft 50 ft 30 ft	Type I - Missouri River, Dearborn River, Sun River, Big Blackfoot River Type II - tribs of Type I water courses Type III - tribs of all type II water courses; all intermittent streams, Missouri River Reservoirs, Lake Helena, Helena Valley Reservoir, and wetlands Type IV - drainage channels capable of carrying storm water and snowmelt runoff and Helena Valley Irrigation District canals.

A natural or properly designed vegetated filter strip or riparian buffer can provide storm water management and act as a floodway sustaining the integrity of stream ecosystems and habitats. Buffers cannot, however, treat all the storm water runoff generated within a watershed and generally effectively treat less than 10 percent of the total watershed runoff. Therefore, structural BMPs must often be installed in addition to treat the quantity and quality of storm-water runoff.

Low Impact Development Techniques

Low impact development (LID) is an alternative, ecologically-sensitive design approach that mimics the way natural areas store and infiltrate rainwater. LID is a relatively new concept in the United States that first gained momentum in Maryland in the early 1990s (LID Center, http://lid-stormwater.net/intro/background.htm). The LID approach protects local and regional water quality by decentralizing storm water conveyance and absorbing rainfall throughout the urban landscape. LID consists of storm water management practices that can be part of a smart srowth and/or green building strategy, but LID techniques only focus on the hydrologic and ecological impacts of development.

LID involves structural and/or non-structural practices that treat storm water at the source. The basic ideas are to promote storage, infiltration, and ground-water recharge via storm water retention and detention areas, reduction of impervious surfaces, and the lengthening of flow paths and runoff time. Structural LID practices include bioretention facilities (i.e. vegetated medians), grass swales, soil amendments, vegetative roof covers or green roofs, permeable pavements, rain barrels and cisterns, and tree box filters (**Figure 4-5**). Non-structural LID practices include planning and management actions, such as the preservation of ecologically sensitive areas (riparian areas, mature trees, steep slopes, etc.), disconnecting rain gutters from the storm sewer system, and minimizing impervious surfaces (i.e. shared driveways).

LID practices require site-specific design and maintenance, but case studies show an overall savings of 25 percent to 30 percent over conventional residential building techniques (LID Center, http://lid-stormwater.net/intro/background.htm). Cost savings and increased aesthetics provided by the incorporated landscaping are incentives for property owners, but there are also benefits to water quality. Bioretention areas and grass swales have been found to be effective at treating metals and nutrients in storm water runoff, as well as reducing runoff volume. A nine month green roof study in North Carolina, has demonstrated 60 percent rainfall retention coupled with an 85 percent reduction in peak flows (EPA 2005). More information on LID can be found at the following EPA website: http://www.epa.gov/owow/nps/lid/.

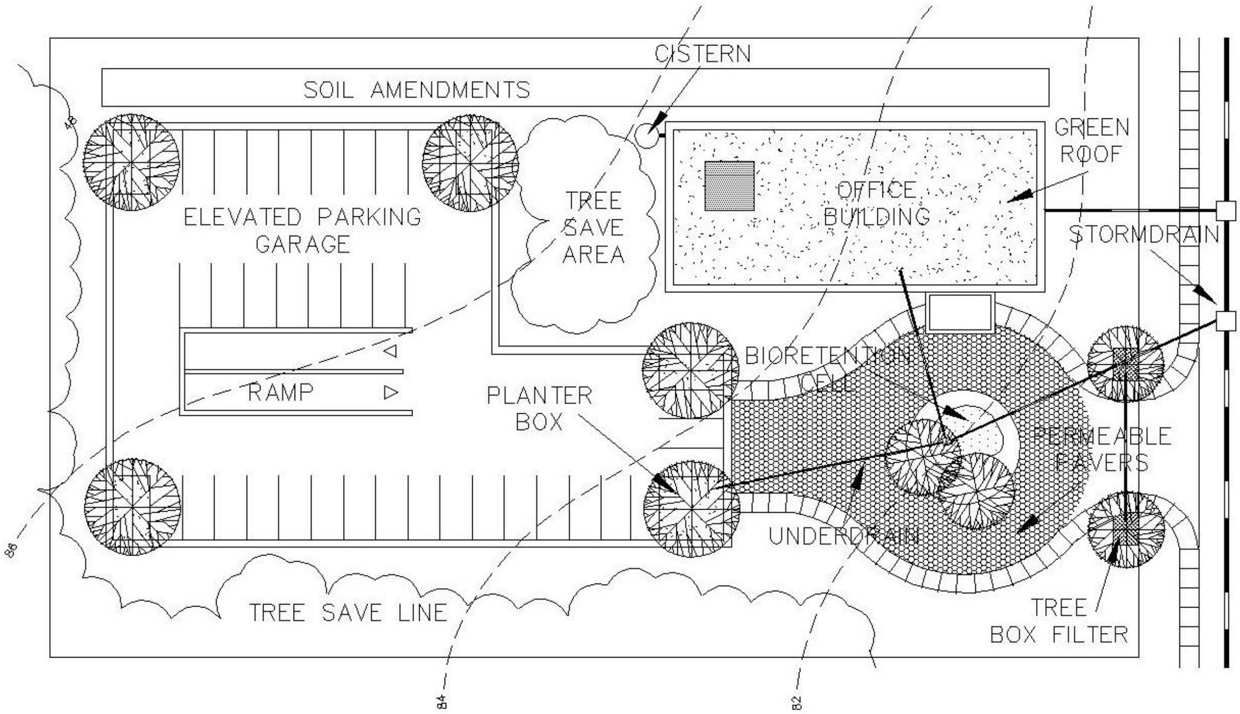


Figure 4-5: LID Urban Office and Parking Example*
*From the *Low Impact Development (LID) Center* http://lid-storm water.net/design_img/design_examples.htm.

Constructed Wetlands

Constructed wetlands are designed to mimic the pollutant-removal functions of natural wetlands and can be a cost-effective and technically feasible approach to treating storm water runoff and wastewater. Montana has seen very limited use of constructed wetlands for treatment of wastewater with only two DEQ-approved municipal systems currently operating. However, the short-term performance data for one of the systems indicate significant nitrogen removal across the wetland. Data displayed in **Table 4-9** indicate that constructed wetlands can also be utilized to provide further treatment for subsurface wastewater treatment systems (septic systems), again at a fraction of the cost of other effluent treatment practices (**Table 4-10**).

Table 4-9 Comparison of Total Pollutant Reductions Achieved with On-Site Wastewater Disposal Systems (EPA 1993a)					
Disposal practice	**Total Suspended Solids (%)**	**Biological Oxygen Demand (%)**	**Total Nitrogen (%)**	**Total Phosporus (%)**	**Pathogens (Logs)**
Conventional Septic System	72	45	28	57	3.5
Mound Septic System	NA	NA	44	NA	NA
Water Separation System	60	42	83	30	3.0
Anaerobic Upflow Filter	44	62	59	NA	NA
Intermittent Sand Filter	92	92	55	80	3.2
Recirculating Sand Filter	90	92	64	80	2.9
Constructed Wetlands	80	81	90	NA	4.0

Table 4-10 Cost of On-Site Wastewater Disposal Systems and Additional Effluent Treatment Practices (EPA 1993a)		
Disposal Practice	**Capital Cost ($/House)**	**Maintenance ($/Year)**
Conventional System	4,500	70
Mound System	8,300	180
Water Separation System	8,000	300
Anaerobic Upflow Filter	5,550	NA
Intermittent Sand Filter	5,400	275
Recirculating Sand Filter	3,900	145
Constructed Wetlands	710	25

Constructed wetlands used as a management practice can be an important component in managing NPS pollution from a variety of sources. They are not intended to replace or destroy natural wetland areas but rather to remove NPS pollution before it enters a stream, natural wetland, or other water body. Constructed wetlands may or may not be designed to provide flood storage, ground-water exchange, or other functions associated with natural wetlands. In fact, if there is a potential for exposure to contamination or other detrimental impacts, constructed wetlands should be designed to prevent infiltration to ground water, and wildlife use should be discouraged. If constructed wetlands are planned and designed correctly, they can provide significant wildlife habitat, water reuse, and public use opportunities.

Further guidance pertaining to BMPs for control of NPS pollution from storm water, septic systems, and roads is included in **Appendix A**.

Montana's NPS pollution control strategies for diffuse urban and suburban related sources are summarized in **Table 4-11** below.

Table 4-11: Montana's Nonpoint Source Strategy for Diffuse Urban and Suburban Pollution Sources

Goal 10: Urban and suburban nonpoint source pollution is reduced through public and private initiatives.

Objective 10.1: Implement urban and suburban pollution management practices on a watershed basis.

Actions:	
10.1a	Assist and support the local land use planning process (i.e. country growth plans, zoning, and subdivision review, city and county commission meetings) so that potential water quality impacts from development and construction are considered on a watershed basis.
10.1b	Provide information to local planners on methods that maximize on-site recharge and infiltration, minimize impervious cover such as disconnecting impervious cover, use of pervious areas for filtering, use of swales rather than curbs and gutters, conserving existing forest cover, and reforesting turf areas.
10.1c	Provide information on LID storm water mitigation for subdivision and building designs (i.e. natural buffers, bioswales, alternate pavers, maintaining soil quality, green roofs, pervious pavement systems, rain gardens, native landscaping, xeriscaping, and green parking etc.). Target construction and development groups.
10.1d	Assist the MS4 municipalities and entities affected by the Phase II Storm water regulations with the development of Storm Water Management Programs.
10.1e	Promote voluntary application of BMPs to prevent and minimize urban and construction storm water runoff.
10.1f	Encourage representatives of municipalities, businesses, construction and other industries, realtors, and developers to participate on watershed councils and committees.
10.1g	Characterize storm water loads for specific pollutants in TMDL development on a watershed basis, taking into account allocations for future growth.
10.1h	Promote the use of the State Revolving Fund to mitigate and/or protect ground water resources from landfill impacts.
10.1i	Provide information to city and county commissioners with land use planning and its ties to water quality. Give examples such as the use of constructed treatment wetlands for storm water runoff retention areas. And highlight examples of successes (Portland, OR) and difficulties (Chesapeake Bay).
10.1j	Conduct and promote campaign and marketing advertisements, highlighting new, innovative and creative ideas to reduce urban/suburban & transportation impacts to water quality.
10.1k	Encourage incentive-based planning with local businesses that includes solutions to water quality impacts from development.
10.1l	Support development of local information and education campaigns to reduce pollutant runoff from all sources, including the construction and transportation industries, businesses, developers, and homeowners.
10.1m	Promote recycling and hazardous waste collection, including home computers and cell phones.

Table 4-11: Montana's Nonpoint Source Strategy for Diffuse Urban and Suburban Pollution Sources	
Goal 10: Urban and suburban nonpoint source pollution is reduced through public and private initiatives.	
Objective 10.2 Reduce nutrient enrichment of surface and ground water from urban and suburban land uses such as septic systems and other nonpoint sources through education and outreach activities.	
Actions:	
10.2a	Provide education materials for policy makers, planners, and landowners regarding the impacts of septic systems (on-site wastewater systems) on ground and surface waters and alternatives for addressing elevated levels of nutrients.
10.2b	Work with CDs and watershed groups to develop local outreach efforts to reduce nutrient impacts associated with urban and suburban land use activities (e.g. lawn and fertilizer applications, confined animals, construction sites, pet wastes).
10.2c	Promote voluntary nutrient reduction programs in rapidly growing areas of the state and/or where elevated nutrient loading to state waters is a concern. New programs in the state could be modeled after the Tri-State Council's Clark Fork River Voluntary Nutrient Reduction Program implemented in 1995.
10.2d	Provide information on the benefits of centralized distribution and treatment of water and wastewater in new developments to encourage community wells and community wastewater treatment systems, or connections to existing centralized systems. Target audiences include city and county commissioners as well as DEQ Permitting Division.
10.2e	Promote constructed wetlands, riparian corridors, and vegetated filter strips for treatment of urban NPS (i.e. storm water runoff, effluent treatment).
Objective 10.3 Reduce nonpoint source impacts associated with urban/suburban road systems.	
Actions:	
10.3a	Review state and federal highway projects that have the potential to affect water quality and provide recommendations for reducing NPS impacts.
10.3b	Reduce the generation of pollutants from road maintenance operations by minimizing use of salts, pesticides, herbicides, and fertilizers.
10.3c	Develop a training program for state and county road maintenance crews to reduce sediment/pollutant loading to water bodies.
Objective 10.4 Encourage cities and counties to develop zoning ordinances and/or regulations which promote water body buffers and setbacks for water quality.	
Actions:	
10.4a	Encourage participation with the Governor's Taskforce on Riparian Protection to promote riparian buffer and stream corridor protection.
10.4b	Provide education materials for policy makers, planners, and landowners regarding the benefits of buffers and setbacks.
10.4c	Make buffers/setback guidance available and easy to apply for city/county/ planners.

Table 4-11: Montana's Nonpoint Source Strategy for Diffuse Urban and Suburban Pollution Sources	
Goal 10: Urban and suburban nonpoint source pollution is reduced through public and private initiatives.	
Objective 10.5 Protect wetlands from adverse storm water impacts.	
Actions:	
10.5a	Provide information to local governments on storm water criteria to provide wetland protection when working in or near wetlands, and working in the contributing drainage area.
10.5b	Provide information to developers to discourage the use of natural wetlands for storm water treatment, particularly the discharge untreated storm water. Avoid locating storm water treatment practices in wetland buffers.
10.5c	Provide information to developers to discourage the use of designs that constrict wetland outlets.
10.5d	Create education & outreach material explaining differences between natural and constructed treatment wetlands, including how to construct effective treatment wetlands.

Note: The symbol denotes an education & outreach action

4.3.8 Resource Extraction and Contaminated Sediment

Working mines are regulated with federal and state permits including point source discharge permits. In order to obtain a permit, mine operators now have to post a bond covering liability for cleanup and restoration. However, abandoned and inactive mines are a significant source of NPS pollution in many Montana watersheds. DEQ's Mine Waste Cleanup Bureau has prioritized 300 sites across Montana. The bureau's activities focus on two primary site types: inactive mine sites addressed under the Surface Mining Coal and Reclamation Act (SMCRA 1977); these sites are known as abandoned mine sites; and also mining related sites addressed under the Federal Comprehensive Environmental Responsibility, Compensation, and Liability Act (CERCLA) or the Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA). These sites are known as Superfund sites. Heavy metals and riparian habitat modification are the main adverse water quality impacts from abandoned mines. In developing WQPs in these watersheds, the water quality planning section will work closely with the Mine Waste Cleanup Bureau. More information about the abandoned mines program can be accessed at http://deq.mt.gov/abandonedmines .

Much of eastern Montana lies atop coal beds that are potential reservoirs of methane gas. The coal bed methane industry estimates that almost 10,000 wells might be drilled in Montana over the next ten years. More than half of these wells will be on federal lands, a fifth will be on state land, and the remainder on private lands. Trapped methane is released from a coal bed by lowering the water level of the aquifer. Wells are drilled into the coal seam. The casing is sealed above the coal and reduced water pressure allows the methane to rise through the well casing. Often, most of the water is discharged on the surface.

Coal bed methane extraction may have several water quality impacts. Increased flows from surface discharge may damage stream beds and destabilize stream banks. Ephemeral or intermittent waterways are especially vulnerable to erosion. Additionally, the chemistry of the water is also a concern. The parameters of concern include sodium, iron, manganese, fluoride, chloride, ammonia, silver, aluminum, arsenic, boron, barium, cadmium, copper, mercury, nickel, selenium, lead, strontium, sulfate, zinc, nutrients, total dissolved solids (TDS), sodium adsorption ratio (SAR), electrical conductivity (EC) and total suspended solids (TSS). Salinity is a particular concern. Too much salt in irrigation water can inhibit plant growth and destroy the productivity of the soil. Some ranchers and other landowners are also concerned that coal bed methane wells will lower the water table and reduce supplies available for irrigation, stock watering, and rural homes.

Montana's strategy for controlling NPS pollution associated with resource extraction activities is based on a goal of mitigating damage from past mining activities while protecting water quality from new resource development activities. In addition, DEQ's NPS Program staff collaborates closely with DEQ's Abandoned Mine Waste Cleanup Bureau in developing TMDLs and WQPs for impacted watersheds. State nonpoint staffs also coordinate within the agency to allow NPS review of draft point source permits that will be issued by the Department for new mines.

The DEQ develops water quality standards to protect all appropriate beneficial uses. The standards include general prohibitions that require state waters to be "free from substances attributable to municipal, industrial, agricultural practices, or other discharges that will create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life" (ARM 17.30.637(1)). The DEQ has developed electrical conductivity and sodium adsorption ratio standards for the Tongue, Powder, and Rosebud watersheds where most of the state's CBM resources are located. These standards are designed to protect existing and future beneficial uses from impacts associated with CBM development.

Metals and long-lived organic toxic pollutants from past mining-related activities, fuel spills, rail yards, wood treatment, and other industrial sources often accumulate in streambeds and lake sediments. These pollutants may be directly toxic to aquatic life and humans or they may be concentrated in tissues of fish and higher animals that feed on aquatic life or fish. Through bioaccumulation, these concentrations can reach levels that are harmful to the health of wildlife and humans. The NPS Program addresses contaminated sediments on a watershed or water body basis. Each source of contamination presents its own set of challenges. Removing and disposing of contaminated sediments is often expensive and creates risks and potentially other water quality impacts, such as dispersion downstream. As appropriate, the NPS Program uses resources from DEQ's Remediation Division as well as other state and federal agencies to address clean up needs associated with contaminated sediments.

To summarize, Montana's NPS pollution control strategy for resource extraction related sources is to use the TMDL development and implementation process to address source characterization and pollutant reductions. It also relies on DEQ's Remediation Division's Hazardous Waste Cleanup and the Mine Waste Cleanup Bureaus (MWCB). The list of sites reclaimed by the MWCB and prioritized short list of Abandoned Mine Lands is found in **Appendix D** and accessible at http://www.deq.mt.gov/abandonedmines/minepdfs/MinePriorityList.PDF.

4.3.9 Hydrologic Modification

Pollution impacts from changes in stream flow or stream channel modifications can have significant negative impacts to beneficial uses of state waters. The Federal Clean Water Act requirements under Section 303(d) for TMDL development, however, have been determined to apply to pollutants only. Hydrologic modifications, in and of themselves, have been determined to be pollution and not a pollutant, and therefore not subject to TMDL development.

The Montana Constitution and state water law provides the people of Montana the right to appropriate water and apply it to beneficial use (MCA 85-2-101). The Water Quality Act of Montana recognizes this right, but also provides “for the protection of the environmental life support system from degradation and provide adequate remedies to prevent unreasonable depletion and degradation of natural resources.” (MCA 75-5-102).

The Nonpoint Source Program approach to addressing negative water quality impacts from hydrologic modifications is two-pronged. The first approach is addressing impacts during opportunities for agency conditions and public comment on licensing or re-licensing of dams. DEQ certifies federal actions and permits to be in compliance with water quality standards through Clean Water Section 401 and can condition permits, if warranted.

The second approach to addressing hydrologic modifications is through the Water Quality Planning/TMDL planning process and subsequent implementation activities. Assessments of instream flow considerations, efficient irrigation, opportunities for water conservation, and reasonable operations of dams and reservoirs are included in the development of watershed Water Quality Plans.

Montana’s NPS pollution control strategies for hydrologic modification related sources are summarized in **Table 4-12** below.

Table 4-12: Montana's Nonpoint Source Strategy for Hydrologic Modifications

Goal 11: Montana waters are protected from hydrologic modification sources of nonpoint source pollution to the maximum extent practicable.

Objective 11.1: Assist in the coordinated protection and management of surface waters that are affected by hydrologic modification activities.

	Actions:
11.1a	Work with Montana FWP on clear criteria for determining and documenting when negative aquatic life in-stream flow impacts are a result of human activities.
11.1b	Review and condition, if warranted, federal actions and permits (e.g.FERC licensing and re-licensing).
11.1c	Assess and provide recommendations for impacts from hydrologic modifications through the watershed Water Quality Plan process.
11.1d	Work with local watershed and monitoring groups to assess potential opportunities to addresss in-stream flow concerns through water conservation,and other appropriate activities.
11.1e	Promote Montana FWP instream-flow leasing programs.
11.1f	Promote water conservation practices. (See Tables 4-4, 4-4-1, and 4-12.)

Note: The symbol denotes an education & outreach action

4.3.10 Recreation

More than 80 percent of all Montana residents engage in outdoor recreational activities and, of those, more than 60 percent participate in water-based activities (MT DFWP 2003). Water-based recreation includes activities on lakes and rivers, along the shores of rivers, streams, and lakes, and in riparian areas. Intensive or inappropriate recreational activities can harm water quality, and poor water quality can degrade recreational activities. Montana households annually participate in the following outdoor recreational activities:

- Swimming or wading (32%)
- Fishing (other than fly fishing) (27%)
- Fly Fishing (13%)
- Boating, motorized (13%)
- Boating, floating, white water rafting and canoe/kayak (11%)
- Off Highway Vehicle (OHV)/All Terrain Vehicle (ATV) travel (10%)
- Water skiing (6%)
- Ice Fishing (5%)

Recreational uses, associated NPS impacts, and control measures are discussed below.

Boating

It has been estimated that 20 percent of Montana's households own at least one boat or water craft. People use boats recreationally on lakes, rivers, and larger streams. Recreational boating contributes substantially to local and state economies. There is high potential for water quality degradation from boating-associated raw sewage, contaminated bilge water, petroleum products, trash, and solvents being released into state waters. Recreation uses, such as swimming, water skiing, and other forms of water contact recreation are adversely affected by water quality degradation, particularly pathogens, petroleum discharges, and algal concentrations. However, the magnitude of these effects or the amounts of recreation-caused pollutants is not known. Contaminants from marinas and recreational boating include sewage (and associated pathogens) and petroleum products and other materials used to operate, maintain, and repair boats. Discharges of treated and untreated sewage from boats may especially be a problem in smaller lakes with poor water circulation, near public swimming areas, and at marinas. Marinas themselves, if improperly designed and sited, may cause water quality problems through habitat destruction and restricted water flows. However, marinas, boating destination sites, and other boating facilities can provide essential services for safe and effective disposal of boat wastes, particularly sewage and petroleum products. Unfortunately, many marinas do not provide sewage pump-outs or recycling facilities. Targeted educational programs are the most promising approach to reducing pollution from boating activities.

Off-Highway Vehicles

Off highway vehicles (OHVs) include motorcycles, all terrain vehicles (ATVs), dune buggies, and other amphibious vehicles. Snowmobiles are not OHVs. Off highway vehicles operating on public lands for recreational purposes must be registered at the County Treasurer Office and display a decal. Repeated travel by OHVs can create concentrated vehicle use areas and trails with excessive sediment and riparian damage, causing elevated sediment and channeling runoff into nearby streams and lakes. In high water quality watersheds, local, state, and federal agencies can proactively address impacts from off-highway vehicles by developing polices and BMPs to minimize, monitor and restore soil and water impacts from existing and new off-highway vehicle routes.

Other Recreational Activities

Fishing and swimming are two recreational activities focused around high quality waters. Perhaps the most noticeable water quality interaction with recreational activities is related to excessive nutrients and temperatures causing explosive algal growths, including toxic biological blooms. These algal blooms can deplete oxygen levels in the water, produce toxic products, kill other forms of biological life, and discourage/limit recreation uses. Montana DEQ is developing nutrient criteria and standards to identify nutrients levels that lead to excessive algal blooms. At this time, there is no systematic statewide inventory of annual algal blooms or investigation of conditions causing algal blooms.

Another impact to recreational fishing is toxic contaminants. Consumption of fish with contaminated tissue exposes humans to excessive levels of contaminants. The Montana Department of Public Health and Human Services has identified approximately 30 Montana water bodies where consumption of fish may pose health risks to humans (Montana Department of Health and Human Services [DPHHS], 2005). These advisories identify waters where fish tissues have elevated levels of mercury and/or PCBs. The 30 Montana water bodies where fish tissues may have elevated levels of mercury and/or PCBs are considered as part of the 303(d) assessments of possibly impaired waters. Those waters with elevated mercury and/or PCBs are scheduled for Water Quality Plan/Total Maximum Daily Load restoration actions. An example is the Big Spring Creek Watershed Water Quality Plan and Total Maximum Daily Loads (DEQ 2005).

Recreational activities centered around water bodies also have the potential to impact the resource. Trails, developed recreational facilities, etc. located adjacent to streams and other water bodies can contribute sediment, nutrients, fecal coli form, and other pollutants to those water bodies. Additionally, invasive species such as zebra striped mussels, Eurasian milfoil, and whirling disease can be transmitted from contaminated to clean water bodies by recreational users.

Montana's NPS pollution control strategy for recreational activities is summarized in **Table 4-13**.

Table 4-13: Montana's Nonpoint Source Strategy for Recreation	
Goal 12: Montana waters are protected from recreational sources of nonpoint source pollution.	
Objective 12.1: Help facilitate the coordinated protection and management of surface waters that may be affected by recreational users and recreational support facilities.	
Actions:	
12.1a	Work with Montana FWP and State Fire Marshal to develop a 'Concentrated Public Use Effects Strategy' for major Montana aquatic recreation locations. This strategy will focus on reducing aquatic nutrients and fueling station spills from local recreation sites, by developing individual marina/FAS spill response activities and improving local fish habitat conditions impacted by recreational boating.
12.1b	Work with local watershed and monitoring groups to assess local recreation sites affected by water quality (algal blooms, etc.) and incorporate into local watershed restoration plans.
12.1c	Use upcoming state algae and nutrient standards for wadeable streams to provide a preliminary listing of streams with algae/nutrient conditions that may impair recreational and biological beneficial uses (DEQ lead agency).
12.1d	Initiate an interagency collaboration with resource partners (land managers such as Forest Service, BLM, DNRC and Plum Creek) to monitor and assess effective land and water BMPs for self-created off-highway vehicle routes, and develop a suggested list of effective BMPs to control/restore soil and water soil impacts from off-highway vehicle uses.
12.1e	Promote education and outreach campaign to targeted recreationalists and outdoor enthusiasts, to provide BMPs for perpetuation of cherished pastimes.
12.1f	Set up signs and postings at fuel pumping areas on lakes to promote pollution prevention practices.
12.1g	Educate marine operators on effects of spilling fuel, boat operation by public and pollution prevention.
12.1h	Set up an interagency (local, state (DPHHS, DEQ, and FWP) and federal) statewide web page of each year's algal blooms (toxic and otherwise), and provide a preliminary assessment of likely conditions creating each algal bloom.
12.1i	Promote expanded curriculum at university level for recreation majors to be educated on impacts of recreational activities.

Note: The symbol denotes an education & outreach action

4.3.11 Atmospheric Pollution

The 2006 Montana Integrated Report identifies atmospheric deposition as a probable source of impairment for four lakes and reservoirs in Montana (totaling over 385,000 surface acres), and seven stream/river segments. Pollutants attributed to atmospheric deposition in Montana include mercury and other metals, nitrogen, phosphorus, and chemicals such as PCBs. Mercury is widespread in the environment, and low concentrations naturally occur in soils. These deposits and other sources such as emissions from coal fired power plants cause elevated levels of mercury in fish in many areas of Montana. Further information regarding mercury and PCB's in Montana fish may be found in the 2005 Montana Sport Fish Consumption Guidelines at: http://www.dphhs.mt.gov/fish2005.pdf. Controlling atmospheric deposition requires significant coordination among state, regional, national, and international agencies, as sources may be far removed from affected water bodies.
Montana's NPS pollution control strategy for atmospheric deposition is summarized in **Table 4-14** below.

Table 4-14: Montana's Nonpoint Source Strategy for Atmospheric Deposition	
Goal 13: Atmospheric deposition sources of water quality pollution are identified and appropriate actions are taken to minimize these sources.	
Objective 13.1: Characterize and quantify contributions of atmospheric deposition to Montana water bodies and reduce/minimize these contributions where possible.	
Actions:	
13.1a	Assess atmospheric sources of water quality pollution in TMDL development.
13.1b	Collaborate with DEQ Air Quality Division to identify atmospheric sources of NPS pollutants in Montana and recommend actions to reduce sources where possible.
13.1c	Support EPA nation-wide air quality monitoring efforts (which include long- term monitoring sites in Montana).
13.1d	Increase public awareness of atmospheric deposition water quality impacts using E&O activities, through work with DEQ Air Resource Management Bureau.

Note: The symbol denotes an education & outreach action

4.3.12 Climate Change

The U.S. EPA recognizes that climate change has effects on aquatic ecosystems (see EPA's climate change website at http://www.epa.gov/climatechange). Recognizing the profound implications that global warming and climate variation could have on the economy, environment, and quality of life in Montana, the Climate Change Advisory Committee (CCAC) was established with the aim of formulating recommendations for specific actions for reducing or sequestering greenhouse gas emissions. More information on this committee and climate change may be obtained on the DEQ website: http://www.mtclimatechange.us.

The sun's energy drives the Earth's weather and climate and heats its surface. Some of this energy radiates back into space, but some of it is trapped by greenhouse gases (carbon dioxide, water vapor and other gases). A natural "greenhouse effect" keeps the Earth warm enough for life to flourish, but if too much heat is trapped, the Earth's climate could change in disruptive and dangerous ways. There is a growing scientific consensus that increasing emissions of greenhouse gases (GHG) are affecting the Earth's climate. That consensus is represented by the work of the Intergovernmental Panel on Climate Change (IPCC), a body established by the World Meteorological Organization and the United Nations to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts, and options for adaptation and mitigation.

In its Third Assessment Report published in 2001, the IPCC noted that the Earth's surface temperature has increased by about 1 degree Fahrenheit in the past century, with much of that warming occurring the past two decades. The IPCC concluded that "In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations." The IPCC also concluded that these increased concentrations are largely attributable to human activities that result in emissions of carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), halogenated fluorocarbons (HCFCs), ozone (O3), perfluorinated carbons (PFCs), hydrofluorocarbons (HFCs). Aerosols, including sulfate particles and black carbon (soot), are also believed to contribute to global warming.

Climate change simulations for the period of 1990 to 2100 based on IPCC scenarios for future GHG emissions yield a globally-averaged surface temperature increase by the end of the century of 1.4 to 5.8°C (2.5 to 10.4°F) relative to 1990, with a mid-range prediction of 3°C (5.4°F). Uncertainty remains in our understanding of how the climate system varies naturally and reacts to emissions of greenhouse gases and aerosols, thus current estimates of the magnitude of future warming will be subject to future adjustments (either upward or downward). The IPCC's Fourth Assessment Report is due in 2007.

If the magnitude of global warming is consistent with the mid- or upper-range of the Intergovernmental Panel on Climate Change (IPCC) simulations, serious and damaging ecological impacts are likely to result. Higher latitudes are predicted to see greater temperature increases than lower latitudes, especially during winter and spring. The IPCC predicts rising sea levels, increased rainfall rates and heavy precipitation events (especially over the higher latitudes) and higher evaporation rates that would accelerate the drying of soils following rain events. With higher sea levels, coastal regions could face increased wind and flood damage, and some models predict an increase the intensity of tropical storms.

Regional and state impacts are harder to predict than large regional or global impacts. Regional models indicate these possible impacts in Montana:

- As climate changes, this could cause some plants and animals to go extinct, some to decline or increase in population, and others migrate to areas with more favorable conditions.
- Diseases and pests that thrive in warmer climates could spread into Montana, such as the West Nile virus that used to be confined to the Mid-East and only recently has spread to the United States.
- Crops and trees that need cooler climates may not grow as well in Montana.

- More severe storms and droughts could affect crop production, pests and growth rates.

Climate change may result in higher stream temperatures and more intense watershed disturbances (i.e. rain events, high stream flows, landslide, etc.) which could affect aquatic beneficial uses including fish populations. In the mountainous regions of Montana, high elevation snowpack serves as a natural water storage system, slowly releasing water into streams and ground water in the spring and summer and recharging in the fall and winter. Climate change has the potential to alter this cycle by reducing the amount of snowpack. As air temperatures warm, the snowpack would likely develop later and melt earlier, causing peak runoff to come earlier in the winter and spring. This could result in decreased stream flows and reduced ground-water levels (Kinsella 2005).

Some experts predict more precipitation in the West, in the form of rain, not snow. This additional rain could speed melting of the snowpack, increasing the likelihood of winter floods, and increased erosion and streambed and bank scouring. Periodic droughts may affect the way water is stored and used, diminishing the amount available for release to maintain flows needed for optimal stream temperatures and aquatic habitat (Kinsella 2005).

Even if global average temperature increases in the year 2100 are in the lower-range of the IPCC scenarios, the models project ongoing increases in temperatures and sea levels well beyond the end of this century. Thus the eventual impacts may be delayed but not avoided.

Globally, many governments are taking steps to reduce greenhouse gas emissions, including introducing emission trading, voluntary reduction programs, carbon or energy taxes, and regulations and standards on energy efficiency and emissions. In the U.S., 40 states have introduced legislation addressing climate change and 400 mayors have committed their cities to reduce emissions (Environmental Defense 2007).

There are many ways that ordinary citizens can lower their impacts which include: reducing water use, choosing energy efficient appliances, buying locally (reduces carbon emissions associated with transportation of products), choosing products from sustainable sources (based on management practices or use of recycled contents), carpooling or walking/biking to work, and buying fuel efficient cars.

Planners, developers, and builders are also becoming more aware of the climate change impacts of construction materials. Materials used in construction have widely varying amounts of greenhouse gases associated with their extraction, refining, manufacture and delivery. The production of cement and steel alone account for over 10% of global, annual greenhouse gas emissions (Burnett 2006). Use of certified wood products from sustainable sources may reduce a building's 'carbon footprint'. For further information on sustainable wood products visit: the Forest Stewardship Council at http://www.fscus.org/ and the American Tree Farm System at http://www.treefarmsystem.org/.

In the U.S., the Green Building Council (USGBC), a building industry coalition, has developed the 'Green Building' concept which takes into account environmentally responsible building design, materials, and functionality. A rating system-- Leadership in Energy and Environmental Design (LEED) evaluates how 'green' a building is (http://www.usgbc.org/). "LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality". The LEED rating system can be applied to every building type and phase from construction to renovation and operation (i.e. recycling programs). LEED certification is voluntary, but many agencies of the federal government and some states have mandates to obtain LEED building certification, generally for new construction. In Montana, LEED certified buildings are just beginning to make their appearance. Seven projects have been registered or certified with the USGBC, with building ownership spanning from the federal government to city government to private and nonprofit organizations. The Bozeman Public Library and the Northern Plains Resource Council's 'Home on the Range' office in Billings are the most recently completed LEED projects in the state.

Montana's NPS pollution control strategy for climate change is summarized in **Table 4-15** below.

Table 4-15: Montana's Nonpoint Source Strategy for Climate Change	
Goal 14: Climate change related effects of water quality pollution are identified and appropriate actions are taken to minimize these effects.	
Objective 14.1: Characterize and quantify potential climate change NPS pollution effects on Montana water bodies.	
Actions:	
14.1a	Identify Montana water bodies and watersheds most susceptible to climate change NPS pollution effects including changes in flow and thermal regimes.
14.1b	Track MT Climate Change Advisory Committee activities to identify strategies which mitigate for water quality effects of climate change.
14.1c	Support temperature and flow monitoring efforts in Montana watersheds.

Table 4-15: Montana's Nonpoint Source Strategy for Climate Change	
Goal 14: Climate change related effects of water quality pollution are identified and appropriate actions are taken to minimize these effects.	
Objective 14.2: Reduce/minimize adverse temperature and aquatic habitat impacts through pro-active management strategies and restoration.	
Actions:	
14.2a	Identify, protect, and restore cold water refuges, including deep pool habitat, and cool spring /ground -water contributions to streams and rivers. Restore valley–bottom stream segments to reconstruct flows. Reconnect flows from headwaters to downstream reaches.
14.2b	Protect and restore riparian areas as stream buffers, which provide shade and reduce NPS runoff. Reconnect rivers with their floodplains.
14.2c	Encourage development of long-term strategies for water use, water conservation, and water lease agreements for maintaining optimal flows for desirable temperature aquatic habitat. Promote by listing both economic and environmental gains.
14.2d	Protect headwater streams and lakes in order to preserve high quality coldwater flows, which in turn maintain suitable downstream conditions. Target outdoor recreational users (hunters, anglers, wildlife viewing enthusiasts, etc).
14.2e	Increase public awareness of climate change water quality impacts through various E&O activities.
14.2.f	Provide information on activities to reduce carbon releases, including carbon sequestration, conservation, direct seed/no-till farming, and buying locally grown food and consumer items. Promote and provide education activities for individuals to learn how to reduce their carbon footprint.

Note: The symbol denotes an education & outreach action

4.4 Nonpoint Source Pollution Education and Outreach Strategy

Since most NPS pollution is generated by individuals, Montana's citizens are both the source of the problem and the answer in effectively addressing nonpoint pollution within our state. The first step in cleaning up and protecting Montana's waters is to raise awareness that people and their land use practices are all part of the problem and must, therefore, be part of the solution. All Montana's citizens benefit from having excellent water quality, and all should be concerned with the effects of NPS pollution. Because it is voluntary that citizens follow BMPs to reduce NPS pollution impacts, tools are needed to encourage all Montana citizens to increase their awareness and stewardship of Montana's water resources. Education and Outreach (E&O) are among those tools; they provide proactive approaches that can build trust through cooperation between various agencies, organizations, Tribes and, most importantly, the public.

There are many overlaps in citizen awareness and the scientific, social and economic factors that contribute to water quality. Some recognize Montana's waters as a source for biological diversity; others view it as a source for first-rate recreational opportunities; while others depend on Montana's waters as a source for economic livelihood. These overlaps and interactions identify priority areas where E&O can most benefit water quality in Montana (see **Figure 4-6**). The common ground found among citizens is where the E&O program can make the most impact. A collaborative effort is imperative for addressing issues and concerns at both the state level as well as at the watershed level.

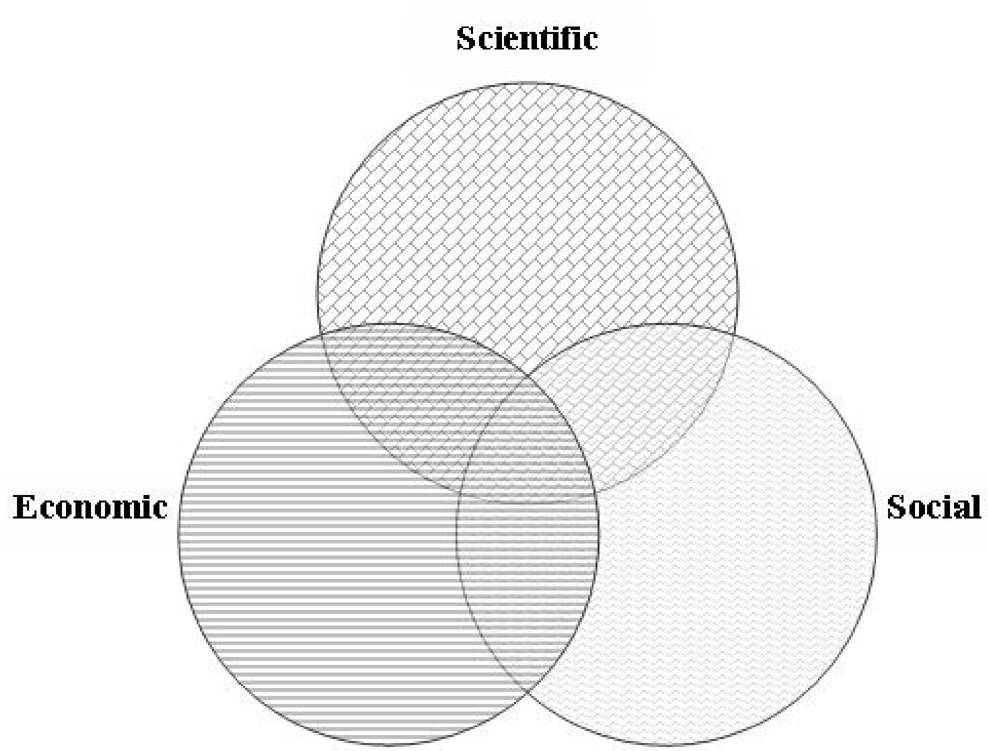


Figure 4-6: Resource Interaction in Effective Education and Outreach

4.4.1 Education and Outreach Plan

As there is no single designated authority in the state assigned to provide NPS pollution E&O, this strategy will provide necessary direction to E&O efforts. This section outlines four main components:

- Target audiences
- Program priorities
- Program goals and objectives
- Implementation actions

These components are intended to increase water quality awareness, build expertise, and assist targeted citizens in taking positive actions to protect, maintain and improve healthy water resources. However, "Simply delivering information to people does not mean they will act on it and make sustainable changes" (Wilbur 2006).

In this section, broad E&O strategies and tools and tactics are introduced, whereas **Sections 4.2 and 4.3** included specific E&O actions for each particular water resource and land use category. Refer to **Table 4-16** below to correlate the water resource and land use-specific E&O strategies to the broader E&O goals, strategies and tactics/tools that follow in **Sections 4.4.4** and **4.4.5**.

Table 4-16: References to E & O Components of Water Resources and Land Use-Specific Nonpoint Source Control Strategies

Water Resources Strategies	**Management Plan Section**
Streams and Lakes	Section 4.2.1
Wetlands and Riparian Areas	Section 4.2.2
Ground Water	Section 4.2.3
Land Use Strategies	
Agriculture: General	Section 4.3.1
Agriculture: Irrigation	Section 4.3.3
Agriculture: Range land	Section 4.3.4
Animal Feeding Operations	Section 4.3.5
Forestry	Section 4.3.6
Diffuse Urban, suburban, and transportation Pollution	Section 4.3.7
Resource Extraction and Contaminated Sediments	Section 4.3.8
Hydrologic Modification	Section 4.3.9
Recreation	Section 4.3.10
Atmospheric Deposition	Section 4.3.11
Climate Change	Section 4.3.12

4.4.2 Targeted Audiences

The NPS pollution E&O strategy is designed to reach a multi-dimensional audience.

Externally, the E&O strategy supports projects that target three audiences:

- Members of the local public which collectively educate and inform a broad audience of NPS pollution issues on a larger scale.
- Professionals working within natural resource fields, including agriculture, forestry, mining, recreation, land development, and transportation, among others. Professionals include Tribes, universities, federal agencies, state agencies, non-profit organizations, businesses, and watershed groups who manage, promote, or affect water resources.
- Educators, both formal and informal.

Internally, the E&O strategy outlines needs actions for DEQ personnel. This strategy focuses on internal communication and better understanding of NPS issues in order to communicate those issues while assisting citizens in understanding water interactions. Together, these external and internal audiences have an improved ability to protect and improve water quality from nonpoint sources.

4.4.3 Education and Outreach Program Priorities

The E&O strategy of the plan is intended to identify water resource needs on both a statewide and watershed level. The plan directs 319 funding to address nonpoint sources of pollution and maintain or improve water quality in Montana. The plan is also meant to encourage collaboration and coordination within Montana DEQ, state and federal agencies, local water quality districts, watershed groups, non-profit organizations, Tribes, universities, and Montana citizens. The E&O strategy within the NPS Plan has been developed to meet the goals of Section 319 of the CWA. In previous chapters of this document, the state's water resources and activities that impact water resources have been defined and addressed. For each water resource and activity, E&O plays an integral role in developing relationships between all Montana stakeholders.

In the previous 2001 edition of the *Montana Nonpoint Source Management Plan*, E&O components were scattered throughout the document. In 2004 the Montana Department of Environmental Quality hosted meetings across the state to identify E&O needs that the agency could manage. These meetings identified components to improve the existing NPS Management Plan. Nine education and outreach actions were identified:

1. Simplify and distribute information about watersheds and government policies
2. Provide information on emerging issues
3. Provide learning sites around the State of Montana
4. Empower local groups to carry out E&O activities
5. Provide regional perspective in E&O materials
6. Focus on high school students
7. Target audience and tailor materials to maximize behavior change (developers, real estate professionals etc.)
8. Provide training and information about BMPs for managing riparian areas, floodplains, and ground water
9. Provide a way to evaluate the success of the E&O program

These actions have been refined and organized to develop the current Education and Outreach strategy. Within the strategy, the target audiences are identified, as well as the goals and means for implementation. As E&O issues and concerns have evolved and increased, it seems appropriate to give specific strategies on how to incorporate actions across various landscape scales, presently and in the future, in the towns and along the waterways of Montana. Four main questions that must be considered when addressing E&O are:

1. Why are we concerned about NPS pollution?
2. What is each person's role in addressing NPS pollution?
3. How will E&O lead to actions to protect and restore water quality and quantity?
4. How will the E&O strategy be implemented?

Education and Outreach efforts should be tailored to fit the various spatial, temporal, and ecological needs that best address NPS pollution issues. Spatially, E&O can address watershed or statewide NPS pollution issues. Temporally, E&O can address immediate and long-term NPS pollution issues. Ecologically, E&O can address stream, river, lake, wetland, and ground-water

NPS pollution issues. To relate ecologic resources, specific E&O actions are listed in the water resources and land use-specific action tables in **Sections 4.2 and 4.3. Table 4-16** cross correlates the specific natural resource and impacts to resource E&O actions to broader E&O goals and objectives.

Within the general population there are specific audiences with differing goals that need to be targeted. Targeting specific audiences through the concept of social marketing can lead to a successful E&O program. Collectively, these audiences would lead to the reduction of NPS pollution by reaching more of the general public. The key water quality and NPS pollution messages should be delivered through vivid communication tools and personal interaction to motivate the public to make behavioral changes. Efforts should focus on connecting human communities with healthy ecosystems.

The E&O strategy will assist in developing crafted and well-designed environmental protection goals, strategies and tactics/tools that meet the needs and interests of the community to close the gap between human and ecosystem communities. High priority E&O projects will address impacts to water resources in areas with completed TMDLs or in areas that have significant physical **and** social changes occurring in them. In this manner, an adaptive E&O program can assist personnel with resource requirement pressures.

The E&O strategy will also assist new residents by building partnerships with neighbors. The strategy guides new residents in making decisions that have both economic and water resource benefits to their property.

4.4.4 Education and Outreach Goals and Objectives

The goals, strategies, tactics, and tools, and evaluation methods are intended to meet communication, education, and action needs. The achievement of the E&O goals and strategies will be measured by evaluating the various actions outlined in the following tables **(Tables 4-17-1 through 4-17-4)**. The communication goal will increase knowledge and awareness of NPS pollution issues. When knowledge and awareness of NPS pollution issues is obtained, a deeper level of understanding is often desired. The educational goals of the E&O strategy are to develop skills and expertise, as well as to improve environmental literacy on NPS pollution issues. Ideally, this newfound knowledge, awareness, and deeper level of understanding will lead to citizens taking responsible actions to improve or maintain healthy water resources.

Strategic social marketing should be used in implementing the various communication, education, action, and evaluation components. Jack Wilbur (Utah Dept of Ag and Food) defines social marketing as: “The application of commercial marketing technologies to solve social problems through sustained behavior change.” Wilbur expands to say social marketing consists of “several basic components, including exchange, positioning, focusing on behaviors, understanding the target audience, creating and delivering messages that will prompt people to change certain behaviors, and forming strategic partnerships with community resources.” The NPS pollution E&O strategy uses these social marketing techniques throughout its four major components (Wilbur 2006).Understanding the barriers to change and motivations for changing behaviors are imperative for having a successful E&O strategy. Having this information before implementing E&O programs is imperative for successful evaluation of those programs.

In order to successfully meet the desired E&O strategy goals, an adaptive management approach will be used. Adaptive management allows change by identifying new priorities and shifting the focus of actions to manage these changes. Having measurable goals and appropriate tools to achieve these goals forms the basis of adaptive management. Monitoring, evaluating and adjusting tools allow the flexibility to meet established goals. Quantifiable evaluation tools should be used so E&O programs can be assessed and modified based on their effectiveness. Additionally, previous and existing efforts should be evaluated and refined for future efforts. The adaptive management approach is essential to the NPS pollution program given that issues, priorities, and concerns change as the program continues to mature.

Goal 1. Communication is defined as the exchange of thoughts, messages, or information through speech, signals, writings, or demonstrating behaviors. The communication goal is to increase knowledge and awareness of NPS pollution issues to promote positive actions.

Communication Objectives: Communicating to Montana water users the impacts on water resources from a particular NPS. Foster a clear awareness and concern about economic, social, political and ecological inter-dependence in urban and rural areas. Collaborate across professional fields to promote and encourage NPS pollution knowledge. Create and position messages to give people a compelling reason to adopt a new behavior, mindset, or lifestyle.

Goal 2. Education is defined as knowledge and skills gained through a learning process. This process can have a wide spectrum of meaning, everything from a teacher in a classroom to a rancher on his land to a professor in a university setting. Specifically, when discussing education in the realm of the environment, this education is referred to as “environmental education.” As defined by UNESCO in 1977, “Environmental education is a learning process that increases people’s knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action.”

The education goals of the E&O strategy are to increase education, to develop skills and expertise on NPS pollution issues, and to improve environmental literacy to create a more aware citizenry that understands NPS pollution issues.

Education Objectives: Provide citizens with opportunities to acquire knowledge, values, attitudes, commitment, and skills needed to protect and improve NPS pollution issues and to promote leadership and community collaboration for problem-solving.

Goal 3. Action as defined within the E&O strategy is an organized activity to turn knowledge, awareness, education, and skills into on-the-ground statewide and local activities. Ideally these actions will be the result of new patterns of behavior and promote civic responsibility. The action goal of the E&O strategy is to increase and track responsible actions by Montana citizens that decrease NPS pollution.

Action Objectives: Create new patterns of behavior towards the environment from individuals, groups, and society as a whole. Encourage water users to take action to protect water resources. Promote investigation, decision-making, and civic responsibility using knowledge, skills, and assessments as a basis for problem-solving and action.

4.4.5 Education and Outreach Actions

The identified necessary actions to meet these goals and objectives for external and internal audiences follow. These actions vary from a statewide level to a watershed level depending on who the audience is. These activities should be used for meeting E&O efforts for the various water resources, as well as land-use related impacts to those resources (e.g. agriculture, forestry, and recreation). External tools to increase communication, education, and action are summarized in **Tables 4-17-1** through **Table 4-17-3**. Internal tactics and tools for DEQ staff are shown in **Table 4-17-4**.

Table 4-17-1: Montana's Nonpoint Source Strategy for Education and Outreach – General Public	
Goal 15: Education & Outreach by General Public Audience.	
Objective 15.1: Effective Communication	
Actions:	
15.1a	Participate in local meetings (watershed groups, city planning, public hearings, land use planning, and others)
15.1b	Communicate BMPs with neighbors.
15.1c	Maintain communication and collaborate with natural resource professionals and state/federal agencies.
15.1d	Publicize local watershed activities and provide calendar of events.
Objective 15.2 Effective Education.	
Actions:	
15.2a	Participate in local educational events and public meetings.
15.2b	Understand how to implement BMPs on the land.
15.2c	Support and participate in learning activities for children and adults.
15.2d	Provide access to private land for educational learning opportunities.
15.2e	Initiate or participate in volunteer water quality monitoring program.
15.3 Effective Action.	
Actions:	
15.3a	Initiate or participate in restoration, service-learning, community service, and clean-up projects in local area (e.g. stenciling project, post signage at fishing access points for aquatic nuisance and invasive species, implement noxious weed management, "adopt a stream" clean-up projects, dog waste clean up in local public areas, and others).
15.3b	Utilize BMPs on private land.

Table 4-17-2: Montana's Nonpoint Source Strategy for Education and Outreach – Natural Resource Professional Audiences	
Goal 16: Education & Outreach by Federal, State & Local Natural Resource Professional Audience – Federal, State and Local Agencies, Tribes, Watershed Groups, Non-profit organizations, and Businesses.	
Objective 16.1 Effective Communication.	
Actions:	
16.1a	Collaborate and communicate with the varying federal, state and local natural resource professionals.
16.1b	Coordinate different existing E&O materials and publicize.
16.1c	Host local public meetings to provide information and updates.
16.1d	Develop a local volunteer network to assist in monitoring, restoration, and other collaborative projects.
16.1e	Coordinate on a regional perspective to communicate Montana's NPS pollution issues to other states.
16.1f	Publish articles and advertisements to meet varying audience needs about NPS pollution issues (e.g. newspapers, Realtor magazines, New West and Headwaters, Barnyards & Backyards, Quivira Coalition, peer reviewed articles).
16.1g	Develop a communication plan that includes key messages on water resources and NPS pollution issues using mixed media.
16.1h	Promote the understanding that conservation is multi-faceted, and multi-dimensional and also requires collaboration and coordination between experts in their various fields (e.g. science, education, policy, economics, marketing, technology, cartography, business, developmental planning).
16.1i	Host booths at natural resource and theconferences (e.g. MACD, MEEA, MWCC, Soil and Conservation District meetings, Chapter society meetings, home shows, MT Association of Realtors, MT Association of Counties and Towns, among others).
16.1j	Promote opportunities for funding resources for state and local projects (e.g. LEP program, CREP, CARRD, EQIP, NSF, mini-grants, and others).
16.1k	Publicize local watershed activities and provide a calendar of events.
16.1j	Support statewide entities such as MWCC to compile watershed planning and management activities into a database and make the information easily available to the public. Assist in coordinating MWCC subcommittee.
16.1m	Identify key partners and locations across the state to empower local entities with information and education opportunities (e.g. Conservation Education Center, Billings, Montana Natural History Center, Missoula, Cook Center, Bozeman, Montana Outdoor Science School, Bozeman; Ravenwood, Big Fork, county extension agents, and others).

Table 4-17-2: Montana's Nonpoint Source Strategy for Education and Outreach – Natural Resource Professional Audiences	
Goal 16: Education & Outreach by Federal, State & Local Natural Resource Professional Audience – Federal, State and Local Agencies, Tribes, Watershed Groups, Non-profit organizations, and Businesses.	
Objective 16.2 Effective Education.	
Actions:	
16.2a	Coordinate a volunteer water monitoring group to collect water quality data and human impacts within a specific watershed.
16.2b	Provide workshops, watershed tours, watershed festivals, and other educational resources.
16.2c	Actively engage and share information from local educational events and public meetings (e.g. New West Realtor and Development Conference, MWCC, city council meetings, planning meetings, watershed group meetings).
16.2d	Educate local landowners and ranch managers on beneficial natural resources on their landscape.
16.2e	Assess to date knowledge of existing programs or projects that are either doing NPS pollution outreach or could be a vehicle for NPS pollution outreach.
16.2f	Correlate water resource and NPS pollution education materials to state and federal student learning standards.
16.2g	Produce various educational materials using mixed media to reach specific audiences (i.e. DVDs, guidebooks, other educational resources).
16.2h	Provide information on water quality issues that promote behavioral changes to instill values and attitudes towards natural resources.
Objective 16.3 Effective Action.	
Actions:	
16.3a	Support and encourage public policies.
16.3b	Coordinate restoration projects (e.g. using the data from water quality monitoring, coordinate a clean up effort or riparian vegetation planting).
16.3c	Support local landowners and ranch managers to implement BMPs (e.g. Timing – Frequency – Intensity, wetland/riparian restoration projects) through development of effective education tools.
16.3d	Contract with advertising, marketing, distribution, etc. companies that use multiple media applications to promote targeted natural resource campaigns.

Table 4-17-3: Montana's Nonpoint Source Strategy for Education and Outreach – Educators	
Goal 17: Education & Outreach to Educators – Formal Classroom Teachers and Nonformal Educators.	
Objective 17.1 Effective Communication.	
Actions:	
17.1a	Assess the needs of formal and informal educators – what they need, how do they need it, when do they need it.
17.1b	Proactively seek E&O from local watershed groups, Conservation Districts, irrigation districts, resource professionals, state and federal agencies.
17.1c	Promote students' successful implementation of water resource and NPS pollution projects to the public (e.g. water monitoring project is publicized in local TV, newspapers and radio, as well as public meetings).
17.2 Effective Education.	
Actions:	
17.2a	Incorporate water resources and knowledge of NPS pollution issues into K-12 student curricula (i.e. Science, Math, Language Arts, Social Studies), specifically middle and high school levels.
17.2b	Utilize educator trunks available through various organizations.
17.2c	Participate in workshops and watershed tours available for educators.
17.2d	Organize and oversee a water quality monitoring program.
17.2e	Encourage development of a category for science fairs and educational competitions and develop an award for best NPS pollution or water quality project.
17.2f	Teach students of all ages to share information and bring home material to parents so an entire community can be involved with specific efforts.
17.3 Effective Action.	
Actions:	
17.3a	Participate in restoration, service-learning, community service, and clean-up projects in local area.
17.3b	Participate (students and educators) in local community meetings.
17.3c	Share water quality data with the public through presentations and publications.

Table 4-17-4: Montana's Nonpoint Source Strategy for Education and Outreach – Internal DEQ	
Goal 18: Education & Outreach by MT Department of Environmental Quality Audience.	
Objective 18.1 Effective Communication.	
Actions:	
18.1a	Coordination and collaboration between bureaus, divisions, and sections through regular meetings.
18.1b	Update and revamp the MT DEQ web site to simplify navigation.
18.1c	Update MT DEQ web site to include simplifying and distributing information about watersheds and government polices.
18.1d	Organize and electronically update databases and libraries and share internally and/or externally.
18.1e	Deliver monthly electronic communication geared specifically toward water resources and impacts on those resources.
18.1f	Build relationships with other local, state and federal agencies through active communication and participation in decision-making processes.
18.1g	Identify existing programs, projects or entities conducting water, water quality or NPS pollution education and develop an NPS pollution product to add to their material.
18.1h	Assure all 319 NPS projects have an education and outreach component.
18.1i	Participate in the project review processes and evaluate and update the guideline criteria.
18.1j	Communicate with others outside of Montana on NPS pollution issues and share learnings from others states to MT.
18.1k	Develop messages of all nonpoint sources and their interrelationship to one another, as well as other resources, people, land uses, behavior, and others.
18.1l	Develop means to utilize the messages (e.g. Public media campaign, materials for educators, annual reports, fact sheets, web sites, hands outs, displays).
18.1m	Assess and survey public's knowledge of NPS pollution issues and how to reach the diversity of the audiences.
18.1n	Establish a list of speakers for NPS pollution issues and develop mechanism to utilize them to reach various audiences (general public, educators, agencies, businesses, and others).
18.1o	Develop presentations that can be used by others (similar to the Room to Roam presentation).
18.2 Effective Education.	
Actions:	
18.2a	Share all Montana 319 project information (general and technical) for the purpose of prevention, restoration, education, further demonstration, and project development.
18.2b	Participate in annual meetings, conferences, and workshops that provide professional development opportunities.
18.2c	Work on a local level to provide surface water, ground water and wetland resource education, as well as education on impacts to those resources.
18.2d	Actively participate in leadership and team building training opportunities.

Table 4-17-4: Montana's Nonpoint Source Strategy for Education and Outreach – Internal DEQ	
Goal 18: Education & Outreach to MT Department of Environmental Quality Audience.	
18.3 Effective Action.	
Actions:	
18.3a	Assist in coordination of training for project sponsors, target audiences, committees, watershed groups, and MWCC.
18.3b	Recognize and address issues and concerns on a state and local level to assist in shaping policy to mitigate NPS pollution issues/concerns.
18.3c	Provide activities for civic engagement, (i.e. restoration activities, water restoration planning, stream clean-ups).
18.3d	Evaluate NPS Management Plan and E&O Strategy, making necessary changes.
18.3e	Evaluate the Water Quality Planning Bureau program annually, reviewing and adjusting program priorities as needed.
18.3f	Evaluate funded E&O projects annually – find the status of the projects, what has been learned, pros and cons, recommendations, and future action.
18.3g	Utilize tools from professional marketing for program evaluation.
18.3h	Develop report formats that each sponsor must complete at the end of a project in order to compile necessary information for annual report and web site.
18.3i	Support projects that demonstrate a thorough needs assessment or documented need, as well as projects with strong NPS pollution components – projects that directly achieve a program goal, collaboration, and non-duplication of efforts.
18.3j	Develop a mechanism to share Montana NPS pollution information outside of MT.
18.3k	Develop program packages for publicizing the NPS Program to be used for the traveling display at professional conferences.
18.3l	Develop training for watershed coordinators, MWCC committees, and other resource professionals on NPS pollution.
18.3m	Contract with advertising, marketing, distribution, etc. companies that use multiple media applications to promote targeted NPS campaigns.
18.3n	Research, utilize and adopt marketing tools for measurements and evaluation.

4.4.6 Education and Outreach Milestones

Education and outreach strategy highest priority milestones for the next five years are outlined in **Table 5-3** in **Chapter 5**. **Table 4-18** summarizes Montana's NPS Educational Outreach Strategy.

Table 4-18: 2007 Montana Nonpoint Source Plan Education and Outreach Strategy Summary Table

Goals	Strategies	Tactics/Tools	Evaluation
COMMUNICATION: Increase knowledge and awareness of NPS pollution issues.	• Communicate to water users on water resources and impacts, both negative and positive . - Resources: Ground water, Surface Water, Wetlands - Impacts: Agriculture, Forestry, Mining, Recreation, Development (urban/suburban), Transportation • Foster awareness and concern about economic, social, political, and ecological interdependence in urban and rural areas. • Collaborate across professional disciplines to promote and encourage nonpoint source pollution knowledge. • Create and position messages to give people a compelling reason to adopt a new behavior, mindset, or lifestyle.	Statewide Level: - Distribute existing educational outreach materials (DEQ, MTWC, DNRC, MACD, watershed groups, etc.) - Communication Plan: create, package, and distribute key messages for intended audiences via mixed media (TV, Radio, Print – Newspaper/Magazines, Outdoor Billboards, Web) - Collaboration and coordination within the state Watershed Level: - Develop a local volunteer network - Host local public meetings to provide information and updates - Collaboration and coordination within the watershed	A suite of potential indicators can be used to measure the effectiveness of all tactics and tools. Examples of evaluation measurements: Programmatic: - Number of newspaper stories printed - Number of people educated/trained - Number of public meetings held - Number of volunteers attending activities - Number of storm drains stenciled
EDUCATION: Increase education to develop skills and expertise on NPS pollution.	• Provide every person with opportunities to acquire knowledge, values, attitudes, commitment, and skills needed to protect and improve NPS pollution issues.	Statewide Level: - Local events, conferences, guest speakers - Water monitoring program development, trainings, and on going support	

Table 4-18: 2007 Montana Nonpoint Source Plan Education and Outreach Strategy Summary Table

Goals	Strategies	Tactics/Tools	Evaluation
Improve environmental literacy to create a more infomed citizenry who understands NPS pollution issues.	• Promote leadership and community collaboration for problem-solving.	- Professional development and training opportunities - Provide ground water/surface water interaction, storm water runoff, and other education modules Watershed Level: - Workshops; watershed tours; watershed festivals; educational trunks - On-going monitoring and certification - Participate in local educational events and public meetings	Social: - Number of calls to a hotline - Number of people surveyed with increased knowledge of NPS pollution issues - Number of people surveyed with changes in behavior - Participation at watershed events - Number of trained volunteer monitors - Number of cities with volunteer watershed groups - Number of volunteer monitoring groups trained
ACTION: Increase and track responsible actions made by Montana citizens regarding NPS pollution issues	• Promote new patterns of behavior of individuals, groups, and society as a whole towards the environment. • Encourage water users to take action on water resources and impacts to water resources. • Promote investigation, decision-making, and civic responsibility using knowledge, skills, and assessments as a basis for problem-solving and action.	Statewide Level: - Create policy to mitigate impacts of NPS pollution - Promote BMPs for land and water resource management - Provide service-learning activities Watershed Level: - Restoration, service learning, community service and clean-up projects	Environmental - Number of gallons of used paint collected - Number of people who have purchased rain barrels - Pounds of trash collected on stream clean-up days - Number of waste bags taken kiosks - Pounds of yard waste collected

4.5 Interagency Coordination

Montana's NPS pollution control program relies on close collaboration with all agencies and organizations that are involved in the protection and restoration of watershed health and water quality in Montana. One of EPA's requirements for state NPS management plans is to describe how the program will work with other agencies and programs to achieve water quality objectives. To address this requirement, Montana DEQ has prepared an extensive appendix describing the partner organizations and activities with which it collaborates on NPS control activities.

Appendix C provides a brief overview of each of the various cooperating entities and their NPS roles and activities. These include federal, state, and local agencies, Tribes, universities, nonprofit organizations, private companies, and other entities that contribute to the stewardship of watershed health and water quality in Montana and lend themselves to a watershed approach. This information is followed by a list of coordination and collaboration opportunities that Montana DEQ's NPS Program will pursue within the watershed framework. In many of these descriptions, both long and short term goals of the NPS Program are addressed. The listing of an opportunity does not imply a commitment or requirement on the part of the associated entity. The purpose of the list is to develop an awareness of the opportunities that could lead to voluntary coordination or collaboration between the NPS Program and the cooperating organization. Collaboration opportunities include unique information the program can contribute to watershed assessments, funding sources, technical assistance, and any other contribution that can be incorporated into the watershed framework

Montana DEQ's policy is to create working partnerships with local agencies and organizations. Conservation districts, water quality districts, land trusts, and environmental and conservation groups are aware of regional problems and are often in the best position to educate citizens and implement water quality protection and restoration projects. DEQ intends to rely on the information presented in **Appendix C** to guide its efforts to coordinate and collaborate with other agencies and organizations whenever and wherever feasible in order to leverage resources and minimize duplication of effort. It is anticipated that the Montana Watershed Coordination Council (MWCC) will be a primary vehicle for facilitating these coordination and collaboration opportunities.

4.6 Nonpoint Source Enforceable Regulatory Programs

The Department of Environmental Quality is required to support a voluntary program of reasonable land, soil and water conservation practices under state law. DEQ's policy and approach towards NPS pollution control recognizes that the cumulative impacts from many NPS activities are best addressed via voluntary measures with assistance from DEQ and other entities. This often applies to agricultural and other small landowner activities along or near streams. However, the state's voluntary policies do not apply to all NPS activities. For certain activities, described in more detail in the sections that follow, there are local, state and/or federal regulations that apply. Examples where non-voluntary approaches are required within the existing regulations include, but are not limited to, streamside management zone requirements for timber production, individual septic system design and location requirements, local zoning requirements for riparian or stream bank protection, and compliance with the 310 law. In other situations where voluntary measures cannot be relied upon to prevent permanent irreversible impacts to water quality, Montana DEQ will promote or pursue the use or development of local, state or federal regulations to avoid these impacts.

Existing regulatory programs for controlling NPS water pollution are described below.

4.6.1 Discharge Prohibitions

Montana's water pollution control law includes some provisions that may be used to take enforcement action against NPS discharges. A general provision prohibits discharges or placement of wastes that cause pollution, including pollution from nonpoint sources (75-5-605).

The water quality code makes it unlawful to "cause pollution ... of any state waters or to place or cause to be placed any wastes where they will cause pollution of any state waters." "Pollution" is defined broadly, and clearly includes pollution from nonpoint sources. However, exempt from the prohibition is "any placement of materials that is authorized by a permit issued by any state or federal agency ... if the agency's permitting authority includes provisions for review of the placement of materials to ensure that it will not cause pollution of state waters."

The Department of Environmental Quality has general inspection and penalty authority for violations of the water quality code, including the discharge prohibition. For alleged violations, the DEQ may serve a notice letter or an administrative notice and order, and may require public hearing of the charges. After finding a violation, a hearing board may issue an order for prevention, abatement, or control of pollution, and administrative penalties.

4.6.2 Other Discharge Limitations

The DEQ has regulatory authority for activities that have the potential to discharge pollutants to state waters that have a NPS pollution component. These activities include construction activities, subdivision development, septic system construction, solid waste disposal, and animal feeding operations. DEQ requires storm water discharge permits for construction activities disturbing more than one acre of land surface. DEQ has authority for ensuring that proposed subdivisions have adequate water and wastewater facilities and meet storm water discharge requirements. DEQ also has regulations requiring minimum design standards (Circular DEQ 4) for septic systems (on-site subsurface wastewater treatment systems).

Landfill discharges of pollutants to ground water are limited by provisions that are licensed by DEQ's Solid Waste Program. DEQ's landfill licenses require corrective action, cleanup, and financial assurance to maintain the state's ground water protection standards (Circular DEQ-7).

DEQ requires permits for CAFOs which discharge to state waters and also requires that AFOs that actually discharge to state waters have discharge permits. Information on and state regulations can be accessed via the state website at: www.deq.mt.gov/wqinfo/MPDES/CAFO.

4.6.3 Agriculture Requirements

The soil conservation code allows for creation of soil conservation districts to conduct research, implement projects and provide technical assistance and education on soil conservation. These districts are authorized to formulate and propose soil and water conservation regulations, which are subject to approval by referendum. Once approved, the regulations may prescribe specific agricultural practices for soil and water conservation within the district. Affected parties may petition for a variance where "there are great practical difficulties or unnecessary hardship in the way of ... carrying out ... the strict letter of the land use regulations." The district's decision whether to issue a variance is reviewable in court. Soil conservation districts have authority to enter and inspect premises to determine compliance with their regulations. They may petition the state district court for an order enforcing the regulations where nonobservance "tends to increase erosion on [defendant's] lands ...and is interfering with the prevention or control of erosion on other lands." The court may order specific performance of required practices or permit the district to perform the work and recover its costs from the landowner.

The Natural Streambed and Land Preservation Act (310 Law) requires that any "project," defined as the physical alteration of a stream resulting in change in the state of the stream, be approved by the local soil conservation district or board of county commissioners before commencing work. Approval decisions are made by the district board based on recommendations made by an onsite inspection team, and are subject to judicial review. The decision is based on multiple factors, including the effects on soil erosion and sedimentation, upstream or downstream flooding and erosion effects, streamflow, turbidity, and water quality effects, and effect on fish and aquatic habitat. Projects engaged in without approval or outside the scope of the approval are declared a public nuisance and subject to abatement proceedings. They are also subject to civil penalties of up to $500 per day and/or a misdemeanor fine of up to $500. However, "customary and historic maintenance and repair of existing irrigation facilities that do not significantly alter or modify the stream" are excluded from the definition of "project," and thus from the approval requirement.

The Agricultural Chemical Ground Water Protection Act covers both pesticides and fertilizers, and requires the Department of Agriculture and the Department of Environmental Quality to cooperate to administer ground-water standards for agricultural chemicals. It requires them to develop numerical standards and interim standards for agricultural chemicals, primarily based on EPA's promulgated and non-promulgated standards under the Clean Drinking Water Act. Both departments are authorized to "implement appropriate actions ... to mitigate any existing impacts of an agricultural chemical found in ground water." These include development of a general ground-water management plan and site-specific management plans, which must be complied by all persons in the covered geographic area. The plans are adopted by rulemaking or with emergency authority. Site-specific management plans may include restrictions on chemical use in certain areas, BMPs, certification, training and licensing requirements, setback areas near water wells, and alternative practices.

It is unlawful to violate any provision of a site-specific ground-water management plan, any order issued pursuant to the Act, or any provision of the Act. Both the Department of Agriculture and the DEQ have monitoring authority. The Department of Agriculture is the lead department for determining compliance with ground-water management plans and is granted inspection authority under the Act. The DEQ is the lead department for determining health risks and may enforce the Act using its enforcement authority under the water quality code. The Department of Agriculture may issue compliance orders, assess administrative civil penalties of up to $1,000 per violation, and file civil actions seeking a temporary or permanent injunction. Violators are also subject to judicial penalties of up to $10,000 per violation and, for intentional violations, criminal penalties of up to $25,000 and/or imprisonment of up to one year, which can be doubled for repeat offenses.

Montana's general pesticide law makes it illegal "to discard any pesticide or pesticide container in a manner that causes injury to humans, domestic animals, or wildlife or that pollutes any waterway in a way harmful to any wildlife in the waterway or to the environment." The Department of Agriculture has general entry, investigation, and enforcement authority for pesticide violations, including violations of the handling, use, and application standards.

Violation of the pesticide law or rules is a misdemeanor, punishable by a fine of $100-$1,500; the department also may issue compliance orders, including cleanup requirements, and/or seek injunctive relief in court. "Major violations," which include misuse that is inconsistent with labeling and results in "proven exposure" or "proven harm" to humans, agricultural commodities, livestock, or the environment, are subject to civil penalties of up to $25,000 per violation; and, if committed willfully, subject to a $50,000 fine and imprisonment of up to 10 years.

4.6.4 Forestry Requirements

When conduction forest practices, Montana's Streamside Management Zone law requires creation of "streamside management zones" for forest streams. A streamside management zone must "encompass a strip at least 50 feet wide on each side of a stream, lake, or other body of water, measured from the ordinary high-water mark and extends beyond the high-water mark to include wetlands and areas that provide additional protection in zones with steep slopes or erosive soils." Within these zones, there are specific prohibitions on certain forest activities:

- Broadcast burning
- Operation of wheeled or tracked equipment (except on established roads)
- Clear cutting
- Road construction unless necessary for stream crossing
- Handling, storage, application or disposal of hazardous or toxic substances in a manner that pollutes water bodies or that may damage humans, land, animals, or plants
- Side-casting of road material into water bodies
- Deposit of slash in water bodies.

There are detailed regulations delineating the stream management zones and defining prohibited practices and site-specific alternative practices. The Department of Natural Resources and Conservation has inspection authority on federal, state, and private land to ensure compliance with the rules for streamside management zones. The department may issue civil penalties of up to $1,000 per day per violation, as well as rehabilitation orders.

The forestry code also contains a section titled "protection of forest resources," (MCA 76-13-101-134) which "encourages" the use of BMPs and includes a requirement that notice be given prior to commencement of any forestry practices. Upon receiving such notice, the DNRC must decide whether to require an onsite consultation with the operator, based on whether "the proposed timber sale is in a high-priority location for watershed resources" or whether "a consultation could contribute to improved watershed management". However, this procedure is not in itself enforceable. The code expressly states that consultation "is intended only for the purpose of providing information to owners and operators and does not confer upon the department or any other agency of state or local government authority to compel an owner or operator to undertake or refrain from undertaking specific management practices that are not otherwise regulated by law or rule".

4.6.5 Development and Other Earth Disturbing Activities

Apart from any programs for the control of urban storm water under the federal CWA or that may be authorized by general land use regulation such as zoning, state law provides the following authorities.

The water quality code allows, but does not require, the creation of local water quality districts "to protect, preserve, and improve the quality of surface water and ground water." County commissions and/or city councils may establish such districts, whose directors may then develop a local water quality program that is implemented through local ordinances, including administrative and civil enforcement and penalties. Specific focuses of the programs include onsite wastewater disposal, storm water runoff, and engine lubricants. The districts also have authority to assess fees for water use, although irrigation and livestock uses are exempt from these fees. Upon approval of the programs, state enforcement authority may be delegated to the district level.

The legislature also has enacted a law protecting lakeshores and declared that “local governments should play the primary public roles in establishing policies to conserve and protect lakes". Under that law, "a person who proposes to do any work that will alter or diminish the course, current, or cross-sectional area of a lake or its lakeshore must first secure a permit for the work from the local governing body."

Local jurisdictions are required to adopt regulations, including criteria for issuing and denying permits for work in lake areas. Factors for consideration include water quality, fish and wildlife habitat, navigation and recreation, public nuisance, and visual and aesthetic values. Regulations and decisions of these governing bodies are judicially enforced and judicially reviewable. Violation of orders or regulations is a misdemeanor, subject to up to 30 days in jail and/or a $500 fine. Violators may also be required to restore the lake to its original state before the unauthorized work was commenced.

4.7 Resources and Funding for Implementing Montana's Nonpoint Source Plan

Resources for funding implementation of the *Montana Nonpoint Source Management Plan* include CWA Section 319 federal funding which is provided to the Montana Department of Environmental Quality for program development and implementation. This federal funding requires a 40 percent non-federal funding match. Montana's "general fund" support for the Water Quality Planning Bureau is used as match for 319 program funds used by the Department for internal NPS Program support. Additionally, 319-funded external projects are required to provide a 40 percent "local match" to the federal funds. Section 319 grant funding levels for NPS control activities during the period 2001-2006 are summarized in **Appendix F** of this document.

Other EPA and DEQ agency funds are also instrumental in funding activities that are related to Montana's NPS management program. These include federally funded CWA Sections 104, 106, and 604 and state general fund support to carry out work related to the agency's responsibilities under the CWA and Safe Drinking Water Act dealing with NPS pollution.

As previously discussed in **Section 4.5**, the NPS Program is heavily reliant upon other federal, state, and local agencies and entities for implementation of the *Montana Nonpoint Source Management Plan*. It is important to point out that in spite of the reliance of the program on other agency resources, the 319 program does not have authority over either the programs or the funds that these entities have or manage.

As suggested earlier, many other funding sources in addition to 319 grants, are available to address to NPS pollution. **Appendix E** contains information on funding available through Montana state agencies for NPS pollution control work. Due to the changing nature of NPS pollution funding and the extensive number of entities and agencies providing funds, they are not listed here, but one excellent information source is the EPA NPS funding website: http://www.epa.gov/owow/nps/funding.

Some of the important other agency resources at the federal level include the U.S. Environmental Protection Agency, U.S. Department of Agriculture (Forest Service and NRCS primarily), U.S. Geological Survey, U.S. Army Corps of Engineers, U.S. Bureau of Land Management, and U.S. Bureau of Reclamation. At the state level key agency resources that work, in part, to support the NPS management program include the Department of Natural Resources (including Conservation and Resource Development, Forestry, Trust Lands, and Water Resources), the State Library (Natural Resources Information System), Montana FWP, the Department of Transportation, and the Department of Agriculture. At the local governmental level important resources brought to bear on NPS pollution include: city and county planning, public health and public works departments (e.g. road maintenance), conservation districts, irrigation districts, and local water quality protection districts.

Finally, numerous non-governmental organizations' resources assist in implementing the *Montana Nonpoint Source Management Plan*. Montana's university and parochial school systems, industry (e.g. PPL, Bonneville Power, AVISTA, ditch companies, and Plum Creek Timber), land trusts and organizations like the River Alliance and the Sonoran Institute, volunteer-supported organizations such as the Montana Watershed Coordination Council, and local watershed groups all devote resources to address NPS pollution.

This tremendous wealth of resources, however, is not enough to address all the NPS Program needs in a five-year or longer timeframe. Therefore it is necessary to prioritize the actions or activities of the NPS management program in a way that maximizes the available resources to accomplish the goal of protecting and improving water quality.

SECTION 5.0 MONTANA'S NONPOINT SOURCE PRIORITIES AND ACTION PLAN

The goal of Montana's Nonpoint Source Management Program is to restore and protect water quality from the impacts of nonpoint sources of pollution in order to provide a clean and healthy environment. The short-term (five-year) goal of Montana's Nonpoint Source Management Program is to demonstrate significant progress in restoring and protecting the water quality of Montana from nonpoint sources of pollution as measured by achieving the actions outlined in this plan.

5.1 Five-Year Action Plan and Priorities

The following tables describe Montana DEQ's five-year action plan for addressing NPS pollution including specific goals, priority actions, and indexes for evaluating success. These five-year goals meet EPA's NPS Program guidance requiring explicit short-term goals.

Table 5-1: Resource Specific Five-Year Goals for the State's Nonpoint Source Plan

Five-Year Goal	Satisfies Objectives (Section 4 Tables)	Measurable Outcome
Complete Water Quality Plans and necessary TMDLs	1.1, 3.1, 3.4	Number of Water Quality Plans and pollutant/waterbody TMDLs completed
Conduct water quality assessments state-wide	1.1, 3.4	Number of updated water quality assessments for state waters
Review/update Integrated Water Quality Report (305(b)/303(d))	1.1	Updated Integrated Reports – 2008, 2010, 2012
Reference site monitoring and assessment	1.1	Number of reference sites monitored and assessed
Increase DEQ internal monitoring support for TMDL program	1.1	Water quality monitoring data for development of TMDLs
Work with watershed groups to develop watershed restoration plans	1.1, 2.1, 3.1, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 6.2	Number of watershed groups with watershed restoration plans
Implement restoration projects identified in Water Quality Plans/TMDLs	1.1, 1.3, 2.1, 3.1, 3.4, 4.1, 4.2, 4.3, 5.3, 6.2, 6.3	Number of restoration projects implemented
Monitor 319 restoration activities for effectiveness and pollutant load reductions	1.1, 2.1, 4.1, 4.2, 4.3, 4.6, 5.3,16.1,16.2	Monitoring SAPs, water quality data collection and assessment, estimates of load reductions
Establish a statewide monitoring strategy for monitoring of 319 and other watershed restoration activities for practice effectiveness, load reductions, and in-stream water quality achievements.	1.1, 1.3, 3.3, 4.3, 6.2, 8.1, 8.2, 9.1, 10.1	A statewide project-monitoring strategy, monitoring SAPs, estimates of load reductions, volunteers conducting watershed monitoring.

Table 5-1: Resource Specific Five-Year Goals for the State's Nonpoint Source Plan		
Five-Year Goal	**Satisfies Objectives (Section 4 Tables)**	**Measurable Outcome**
Conduct 5-year reviews of completed and implemented TMDLs	1.1, 2.1, 4.1	Number of 5-year reviews conducted
Collaborate with federal, state, and local agencies to promote conservation tillage (no-till, direct seed),vegetated filter strips, and riparian buffers	1.1, 4.2, 4.3, 12.2	Acres of conservation tillage (no till, direct seed), miles of vegetated filter strips, and riparian buffers, participants at conservation tillage workshops
SMZ review for protection of water quality, 2 facets: 1)restored watershed monitoring 2)collaborative research projects (i.e. DNRC & Plum Creek)	1.1, 2.1, 2.2, 8.1	Number of reviews completed, number of research projects completed
Overlap priority areas with USFS/DNRC using GIS for coordinating watershed planning process (needs assessment versus existing budgets)	7.1, 7.2, 9.1	Number of Forests with completed GIS overlay
Work with MSU Extension, DNRC, USFS R8, NRCS, and BLM to develop a targeted list of BMPs for grazing (those that achieve water quality standards)	2.3, 3.1, 6.1, 6.2, 6.3, 7.1, 7.2, 7.2, 7.2	Agencies participating in implementation of water quality BMPs, number of acres grazed with BMPs that are protective of water quality
Provide reviews and comment on outside agency proposed projects	1.1, 1.2, 2.1, 2.2, 3.2	Number of reviews completed
Develop, maintain and enhance Clean Water Act Information Center public access to data system	1.1, 15.1, 15.2, 16.1, 16.2	System operable and available to public
Administer STORET water quality database system	1.1, 3.1, 18.1	STORET uploads of DEQ monitoring data every 6 months, all relevant DEQ in-stream monitoring data available in STORET
Administer web-based STORET Interface Module for non-DEQ STORET data submittals	1.1, 3.1, 16.1, 16.2	Continued and expanded use of web-SIM by partners external to DEQ, technical assistance to outside users
Initiate monitoring project for "large rivers" (e.g. Missouri, Yellowstone)	1.1, 12.1	Development of monitoring protocols for large rivers

Table 5-2: Policy Directed Five-Year Goals for the State's Nonpoint Source Plan		
Five-Year Goal	**Satisfies Objectives (Section 4 Tables)**	**Measurable Outcome**
Provide 319 funding to projects that implement NPS and TMDL water quality restoration strategies	2.3, 4.1, 4.2, 4.3, 5.1	Number of projects implemented
Develop and implement DEQ water quality improvement MOUs with agencies including USFS, BLM, DNRC, MDT, and MFWP	1.1, 1.3, 2.1, 3.1, 3.4, 4.1, 4.2, 5.1, 6.3, 7.1, 7.2, 9.1	Number of MOUs signed, clarified agency roles and responsibilities for addressing NPS pollution

Table 5-2: Policy Directed Five-Year Goals for the State's Nonpoint Source Plan		
Five-Year Goal	**Satisfies Objectives (Section 4 Tables)**	**Measurable Outcome**
Assist in efforts to develop a cumulative impact assessment strategy for ground-water impacts in high density septic/development areas	2.1, 2.2, 2.3	Septic system cumulative impacts assessment strategy.
Assist in the review of subdivision storm water rules.	3.1. 3.2, 3.5 10.1, 10.5	Potential revisions to DEQ 8.
Implement collaborative monitoring processes with federal, state, and local agencies on federal and state land projects, focusing on riparian zone management in achieving water quality standards	1.1, 2.1, 3.1 7.1, 7.2, 9.1, 12.1, 12.2	Number of SOPs/SAPs developed with DEQ collaboration, number of contracts/leases renewed with riparian zone targets & water quality monitoring
Continue water quality participation in the ITEEM process by collaborating with the IRTWG group	1.1, 2.1	Projects reviewed under ITEEM
Develop numeric nutrient water quality standards and implementation procedures for surface waters	1.1, 3.1, 3.3, 10.1	Numeric nutrient water quality standards and implementation procedures for flowing waters
Develop technical basis for a lake classification system based on nutrient status	1.1, 3.1	Scientifically defensible assessment tool for developing lake nutrient standards
Promulgate numeric standards for all pesticides identified in Montana ground and surface waters.	5.3	Adoption of numeric standards for all pesticides within 2 years of DEQ notification of detection in state waters
Develop biocriteria for wadeable streams	12.1	DEQ acceptance of accurate, defensible biological assessment tools
Develop Standard Operation Procedures (SOP) for monitoring intermittent streams	3.1, 3.3, 5.1	SOP adopted, number of streams assessed using SOP
Review and recommend revision or update of Montana's Ground-Water Plan	3.1, 3.2	DNRC recommended Ground-Water Plan revisions to EQC
Form a MS4 task force to promote and coordinate stormwater management activities	10.1, 10.1	Number of meetings, number of communities participating, number of LID demonstration projects

Table 5-3: Education and Outreach Five-Year Goals for the State's Nonpoint Source Plan		
Five-Year Goal	**Satisfies Objectives (Section 4 Tables)**	**Measurable Outcome**
Provide support and promote the development and coordination of watershed groups through MWCC activities, training workshops, advertising campaigns, etc.	1.1, 2.1, 2.3, 3.1, 4.3, 16.3	Amount of funding going towards MWCC or advertising activities, number of workshops held, number of participants, number of watershed groups using advertising and promotional resources

Table 5-3: Education and Outreach Five-Year Goals for the State's Nonpoint Source Plan		
Five-Year Goal	**Satisfies Objectives (Section 4 Tables)**	**Measurable Outcome**
Support the certification of volunteer monitors in watershed groups	1.1, 2.1	Number of watershed groups with certified volunteer monitoring programs, number of sampling events, increased quality and reliability of data based on appropriate QA/QC protocols
Improve DEQ website for public access to information on NPS Program	2.1, 3.1, 4.6, 5.3, 9.1, 16.1, 16.3	Hits on DEQ website, public feedback of new DEQ website
Develop educational campaign: Urban growth and development issues (i.e. storm water runoff, septic system maintenance, transportation infrastructure, low impact development)	1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 10.1, 10.2, 16.1, 16.3	Number of local governments addressing NPS issue, number of communities with NPS education & outreach activities
Develop educational campaign: Riparian and wetland buffer protection	1.1, 1.2, 3.1, 4.3, 10.2, 10.4, 10.5, 12.2, 16.1, 16.3	Number and types of ad campaigns. Delivery of message, numbers and acres of wetlands and miles of riparian areas protected.
Develop educational campaign: Small farm and ranch conservation. Work with NRCS, DNRC, MSU Extension, and Farm Bureau	1.1, 2.1, 2.2, 3.1, 4.2, 4.3, 4.4, 5.1, 6.2, 10.2, 16.1, 16.3	List of priority focus areas, number of land owners attending workshops, distribution of campaign materials, number of small farm and ranch management plans developed
Work with Statewide organizations (i.e. MEEA, Project WET) to establish and expand water curriculum in schools	1.1, 2.1, 9.1, 16.1	New water resource curriculum, number of teachers using curriculum, number of students participating in workshops or trainings, hits on MEEA and Digital Library for Earth System Education (DLESE) websites
Develop and promote BMP training for road maintenance personnel using Local Technical Assistance Program (LTAP) and other venues	1.1, 7.1, 8.1, 10.3, 16.1	Number of trainings held, number of participants trained, transportation funding allocated to BMP installations or activities.

SECTION 6.0 – MEASURING SUCCESS

Montana's policy is anchored in a voluntary program of reasonable land, soil, and water conservation practices to achieve compliance with water quality standards for nonpoint pollution reduction activities. Most of these conservation practices are accomplished through the efforts of landowners, local watershed groups, and conservation districts. These watershed groups have valuable knowledge and experience of local conditions and provide for practical watershed restoration activities. Local watershed groups are able to form partnerships for creative problem solving and successful restoration funding.

Coordinated locally-led watershed restoration strengthens Montana DEQ's role in leveraging expertise, resources, and policy cooperation involving cooperation with other government agencies, private groups, and volunteers in program development, resource and social monitoring, data collection, and water quality restoration. DEQ will provide staff support and funding to local watershed efforts engaged in comprehensive watershed restoration, using a continuing cycle of assessment, planning, implementing, and monitoring. This "adaptive management" framework helps ensure restoration success through a feedback loop which adapts restoration approaches and program activities. Adaptive management is a cycle of setting outcomes/goals, strategically selecting tools to achieve the outcomes, strong stakeholder collaboration in program activities, and sharing of results, monitoring of both resource integrity and social acceptability of water programs, overall resource and program effectiveness assessments, and collaborative outcome/goal adjustments based on learning from prior activities.

The NPS Program goals described in Chapter 5 identify the activities supporting NPS Program success over the next five years to present which activities are most likely to result in sustained improvements in statewide water quality. Actual water quality standards achievement is the ultimate goal, but achieving statewide success requires setting a solid framework of actions to support sustained improvements in natural systems. This plan uses an adaptive management approach to achieve the long term goal of clean water statewide.

6.1 Water Quality Monitoring for Success

Monitoring of water quality is clearly a critical component of program evaluation and includes biological, chemical and physical aspects. This information can be, and is, collected by many different entities. It is DEQ's role to assess the information collected and determine if water quality standards are being achieved at the water body and statewide level. One of the NPS Program's priority activities is to continue to foster coordination of field sample collection and resources. Current coordination and collaboration with other entities can be found on the 2006 Integrated 303(d)/305(b) Water Quality Report for Montana under part C-1-Monitoring Program.

Two different levels of water quality monitoring are necessary to assess effectiveness and progress of the NPS pollution control program. The first of these is effectiveness monitoring which addresses how well a specific practice or project reduces pollution. This information is important to ensure that the right types of practices are being implemented. Secondly, trend, probabilistic, target or rotational monitoring provides a broader perspective. This level of monitoring addresses the question of whether water quality standards are being met or if progress is being made towards achieving the standards.

Effectiveness monitoring is required for Montana's 319-funded projects as a part of each implementation project contract. Additionally, Montana state law requires monitoring and evaluation of TMDL effectiveness after reasonable land, soil, and water conservation practices have been implemented to assess compliance with water quality standards and long-term effectiveness of the practices. The other types of monitoring are part of a process intended to protect and improve the quality of the Nation's rivers, streams and lakes under the CWA Sections 303(d) and 305(b).

Water quality monitoring information that is appropriately collected and reported is evaluated by the DEQ Water Quality Planning Bureau's Monitoring and Assessment and Data Management sections and reported within the biennial "Integrated Water Quality Report for Montana".

The resource directed goals described in **Table 5-1** in **Section 5** identify the actual measurable outcomes that will be used to determine success of the program over the next five years, most of which will be derived from water quality monitoring activities.

6.2 Other Resource and Policy Measures of Success

Besides actual standards attainment or trends in water quality, there are many other appropriate measures of success of Montana's NPS Management Program. Some measures are directly linked to water quality monitoring, and others do not have a direct connection. For example, the actual development of nutrient and biological criteria are a measurable outcome and appropriate measure of success of the program that are directly related to water quality monitoring. Alternatively, the acres of wetlands protected through easements and buffers, or miles of stream bank protected by local ordinances are not directly linked to in-stream water quality monitoring but have a positive impact on water quality and are an appropriate measure of program success. Examples of even more indirect measures of success of the program are number of riparian protection brochures distributed or children in grade schools in the state participating in Project WET.

The resource directed goals described in **Table 5-1** in **Section 5** and the policy directed goals described in **Table 5-2** identify the actual measurable outcomes that will be used to help determine success of the program over the next five years.

The resource directed goals described in **Table 5-1** identify the goals of the NPS Program that should be used to determine success of the program over the next five years, and which are most likely to result in actual changes in water quality at the watershed level. Actual water quality standards achievement is the end goal, but this may take years to achieve and is difficult to demonstrate in the short-term (e.g. five-year timeframe) given the variability of natural systems, the limited resources available to address the problems, and the nature and extent of the NPS pollution problem. Therefore, setting interim goals (i.e. five-year goals) is appropriate.

Montana DEQ provides annual NPS Program evaluation reports to EPA detailing statewide activities and accomplishments and these provide some measure of program effectiveness and overall progress. EPA also evaluates the Montana NPS Program using its own strategic targets and program activity measures and works with MDEQ in reporting on the progress towards accomplishment of those measures. These include:

- Number of water bodies partially or fully restored
- Number of watershed-based plans supported by the 319 program
- Estimated pounds of nitrogen reduced from 319 projects in N impaired waters
- Estimated pounds of phosphorus reduced from 319 projects in P impaired waters
- Estimated tons of sediment reduced from 319 projects in sediment-impaired waters
- Watershed trends towards meeting water quality standards

6.3 Education and Outreach Program Evaluation

Evaluation mechanisms must be in place to ensure the success of the E&O strategy. A suite of potential indicators can be utilized to measure and monitor the effectiveness of the actions. After evaluation of the effectiveness of these tactics and tools, the prioritized goals and tools to address the goals can be refined to meet new issues and concerns. This approach is consistent with the aforementioned adaptive management program. Statistical analysis of evaluation efforts is encouraged to demonstrate the effectiveness of meeting the strategy's goals.

Evaluation mechanisms can measure both qualitative and quantitative elements of programmatic and social or environmental impacts of E&O efforts. Programs must have an evaluation strategy at the beginning and implement checks to ensure goals are being met. In addition, short-term and long-term outcomes should be evaluated. Short-term outcomes refer to attitude adjustment and behavior change. Long-term outcomes refer to collective reductions in NPS pollution. Future E&O funding should focus on short-term outcomes while collectively these outcomes will address the DEQ long-term goals of reducing NPS pollution. Various short-term evaluation tools used by grant funded programs towards implementation follow.

- Pre- and post-evaluations: to measure changes in knowledge, behavior, and attitudes toward nonpoint source pollution.
- Interviews: to measure audience perception, attitudes and beliefs at a local level.
- Focus groups: to measure knowledge, behavior and attitudes of nonpoint source pollution issues either prior to, during, and/or after a particular outreach and education effort (e.g. focus group prior to a public media campaign to measure what a certain audience knows about nonpoint source pollution, or particular issue, and what means of reaching them would work best or after a media campaign to measure the effectiveness and awareness of the campaign).
- Questionnaire/Survey: phone or web surveys to measure knowledge, behavior, or attitudes toward NPS pollution or particular issues.
- Observation: to measure behavior and attitudes towards a particular NPS pollution issue.
- GIS mapping analysis: utilize mapping technology to illustrate spatial and temporal differences.

Long-term evaluation will be DEQ's responsibility through assessing NPS pollution impact changes over time. Improved water quality and a reduction in NPS pollution can be measured by using the collective short-term impacts, as well as scientific-based water quality modeling and monitoring (Wilbur, 2006 draft).

SECTION 7.0 ADDITIONAL INFORMATION RESOURCES

A vast amount of information can now be gained through many online resources and links developed by various entities. Federal and state agencies, Tribes, universities, local communities, non-profit groups, private companies and volunteer groups are just some of the entities that have information up on websites. Below is a starting list of websites that provide information on water resource topics. Topics can range from BMPs, to news events, informative articles, or interactive education materials. Be aware that many other informative links can be found just by reading and working through listed websites.

Army Corps of Engineers
ACOE: http://www.usace.army.mil/
HEC Programs: http://www.hec.usace.army.mil/
Mitigation: http://www.usace.army.mil/inet/functions/cw/cecwo/reg/mitigation_action_plan.htm
Nationwide Permits:
http://www.usace.army.mil/inet/functions/cw/cecwo/reg/nationwide_permits.htm
Technical & Biological Info:
http://www.usace.army.mil/inet/functions/cw/cecwo/reg/techbio.htm

BLM
BLM-Montana/Dakotas: http://web.mt.blm.gov/
BLM National Science Center: http://www.blm.gov/nstc/
BLM Riparian Database: http://www.ecologicalsolutionsgroup.com/Lasso/default.html
BLM Tech References: http://www.blm.gov/nstc/library/techref.htm
BLM Library: http://web.nc.blm.gov/blmlibrary/http://library.doi.gov/
BLM Search Engine: http://web.blm.gov/search/
National Riparian Service Team: http://www.blm.gov/or/programs/nrst/index.php
National Fluids Conference: http://www.wy.blm.gov/fluidminerals04/presentations.htm
Oil and Gas BMPs: http://www.blm.gov/bmp/
Post Fire Stabilization: http://web.blm.gov/internal/wo-200/wo-220/ESR/index.htm
Water Quality Law: http://www.blm.gov/nstc/WaterLaws/abstract2.html

EPA
Climate Change: http://www.epa.gov/climatechange
EPA: http://www.epa.gov/
Education & Outreach: http://www.epa.gov/owow/nps/eduinfo.html
Fundamentals of Classification: http://www.epa.gov/watertrain/stream_class/
Funding: http://www.epa.gov/owow/nps/funding
Ground Water and Drinking Water: http://www.epa.gov/safewater/mcl.html#mcls
LID Program: http://www.epa.gov/owow/nps/lid/
National Service Center for Environmental Publications: http://nepis.epa.gov/ The EPA
Non-point Source BMPs for Forestry: http://www.epa.gov/owow/nps/forestrymgmt/
Program Evaluations: http://www.epa.gov/nps/toolbox/surveys.htm
Roads: http://www.epa.gov/owow/nps/sensitive/sensitive.html
Stormwater and Construction Industry: www.epa.gov/npdes/stormwater
Stormwater BMP's: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm.

TMDLs: http://www.epa.gov/owow/tmdl/2006IRG/
Water Quality Standards: http://www.epa.gov/waterscience/standards/
Watershed Assessment of Stability & Sediment (Rosgen):
http://www.epa.gov/WARSSS/index.htm
Watershed Plan Builder:
http://iaspub.epa.gov/watershedplan/planBuilder.do?pageId=51&navId=39
Wetlands: http://www.epa.gov/owow/wetlands/

NRCS
Aberdeen (ID) Plant Materials–Rip & Wetlands: http://www.plant-materials.nrcs.usda.gov/idpmc/riparian.html
Basin Outlook Reports: http://www.wcc.nrcs.usda.gov/cgibin/bor.pl
Buffers: www.nrcs.usda.gov/future/buffers
Ecological Site Information: http://esis.sc.egov.usda.gov/
General NRCS Website www.nrcs.usda.gov
Montana Office: http://www.mt.nrcs.usda.gov/
Montana Plant Materials Program: http://www.mt.nrcs.usda.gov/technical/ecs/plants/
Montana Riparian and Floodplain:
http://www.mt.nrcs.usda.gov/technical/ecs/water/setbacks/index.html
Montana Soils: http://www.mt.nrcs.usda.gov/soils/
Montana Water and Snow: http://www.mt.nrcs.usda.gov/water.html
MT Water Supply & Reservoir Storage: http://www.mt.nrcs.usda.gov/snow/watersupply/
National Soils: http://soils.usda.gov/
Organic Farming: http://www.mt.nrcs.usda.gov/technical/organic
Web Soil Survey: http://websoilsurvey.nrcs.usda.gov/app/
Urban Conservation: http://www.ia.nrcs.usda.gov/news/brochures/urbanfactsheets.html
Vegetated Filter Strips: http://www.nrcs.usda.gov/feture/buffers

USFS
Region 1: http://www.fs.fed.us/r1/
Region 1 Air Quality: http://www.fs.fed.us/r1/gallatin/resources/air/index.shtml
Aquatic and Riparian Ecosystems (Fort Collins): http://www.fs.fed.us/rm/rwu4352/
BAER Treatment Monitoring: http://forest.moscowfsl.wsu.edu/engr/weather/
Burned Area Emergency Rehab: http://fsweb.gstc.fs.fed.us/baer/
Great Basin Watersheds/Ecosystems (Reno): http://www.ag.unr.edu/gbem/
Pacific NW Research Station: http://www.fs.fed.us/pnw/
Pacfish-Infish Monitoring: http://svinetfc4.fs.fed.us/pibo/
Rocky Mountain Research Station: http://www.fs.fed.us/rm/
San Dimas Research and Development: http://www.fs.fed.us/eng/techdev/sdtdc.htm
San Dimas R&D (Intranet): http://fsweb.sdtdc.wo.fs.fed.us/
State Ground-Water Laws:
http://fsweb.r1.fs.fed.us/wildlife/wwfrp/hydro/state_gw_laws_2005.pdf
Stream Team: http://www.stream.fs.fed.us/
Watershed Erosion Modeling: http://forest.moscowfsl.wsu.edu/engr/software.html

USGS
USGS: http://www.usgs.gov/
Benchmark Hydrologic Stations: http://pubs.usgs.gov/circ/circ1173/
Current Stream Flow Data: http://waterdata.usgs.gov/mt/nwis/current?type=flow
Hydrologic & Erosional Responses of Burnt Wshds:
http://wwwbrr.cr.usgs.gov/projects/Burned_Watersheds/index.html
National Hydrography Dataset (NHD): http://nhd.usgs.gov/
Northern Rocky Mountain Science center: http://nrmsc.usgs.gov/index.html
Open File Reports: http://pubs.usgs.gov/of/index-water.html
Science in Your Watershed: http://water.usgs.gov/wsc/map_index.html
SURF Your Watershed: http://cfpub.epa.gov/surf/locate/index.cfm
Water Cycle (Education): http://ga.water.usgs.gov/edu/watercycle.html
Water Resources of Montana: http://mt.water.usgs.gov/
Water Resource Reports: http://water.usgs.gov/pubs/
Western Wetland Flora:
http://www.npwrc.usgs.gov/resource/plants/florawe/species/2/phleprat.htm

Other Federal
National Biological Information: http://mpin.nbii.org/portal/server.pt
National Wetlands Inventory: http://www.fws.gov/nwi/

Montana DEQ
Abandoned Mines List: http://deq.mt.gov/abandonedmines/minepdfs/mineprioritylist.pdf
AFO/CAFO: http://deq.mt.gov/wqinfo/mpdes/cafo.asp
Circular WQB-7: http://deq.mt.gov/wqinfo/Circulars/WQB-7.PDF
Climate Change: http://www.mtclimatechange.us
Coalbed Methane: http://deq.mt.gov/CoalBedMethane/index.asp
DEQ: http://deq.mt.gov/index.asp
DEQ Discharge Permits: http://www.deq.mt.gov/wqinfo/WaterDischarge/Index.asp
DEQ Discharge Permits: http://www.deq.mt.gov/wqinfo/MPDES/PermitTypes.asp
Nonpoint Source Annual Reports: http://www.deq.mt.gov/wqinfo/nonpoint/AnnualReports
Permitting: http://deq.mt.gov/Permits.asp
Source Water Protection Database: http://nris.state.mt.us/wis/swap/swapquery.asp
TMDLs: http://deq.mt.gov/wqinfo/tmdl/index.asp
Water Quality: http://deq.mt.gov/wqinfo/Laws.asp
Water Quality Assessment Database: http://deq.mt.gov/CWAIC/default.aspx
Water Quality Rule: http://deq.mt.gov/dir/legal/Chapters/Ch30-toc.asp
Water Quality Statutes: http://deq.mt.gov/wqinfo/Laws.asp
Wetland Conservation: http://deq.mt.gov/wqinfo/Wetlands/Index.asp
Wetlands in Montana (biocriteria): http://www.epa.gov/owow/wetlands/bawwg/case/mtdev.html

DNRC
DNRC: http://dnrc.mt.gov/
Water Quality BMPs for Montana Forests:
http://dnrc.mt.gov/forestry/Assistance/Practices/Documents/2001WaterQualityBMPGuide.pdf

Water Resources Division: http://dnrc.mt.gov/wrd/default.asp
Water Rights: http://dnrc.mt.gov/wrd/water_rts/default.asp
Water Rights Query System: http://nris.mt.gov/dnrc/waterrights/default.aspx

NRIS
NRIS: http://nris.state.mt.us/wis/
NRIS- GIS: http://nris.state.mt.us/gis/
Map Builder: http://maps2.nris.state.mt.us/mapper/
River Basins: http://nris.state.mt.us/wis/mrispdfs.html
Watershed Boundaries: http://nris.state.mt.us/nsdi/watershed/
Water Information System: http://nris.mt.gov/wi.asp

Miscellaneous Montana
Department of Transportation Studies (Erosion, Fish):
http://www.mdt.mt.gov/research/projects/res_final.shtml
Department of Transportation (Wetlands):
http://www.mdt.mt.gov/other/environmental/external/wetlands/
Fish Consumption Advisories: www.dphhs.mt.gov/fish2005.pdf
Ground-Water Information Center, Montana Bureau of Mines and Geology:
http://mbmggwic.mtech.edu/
Local Technical Assistance Program (LTAP): http://www.coe.montana.edu/ltap/index.html
Montana Environmental Education Association: http://www.montanaeea.org
MSU Extension Program within the Dept. of Animal Range Sciences:
http://animalrangeextension.mt.edu.
MSU: Septic Tank & Drainfield: http://www.montana.edu/wwwpb/pubs/mt9401.html.
MSU: Watershed Hydrology: http://landresources.montana.edu/watershed/
MSU Extension Water Quality Program: http://waterquality.montana.edu
MSU Department of Land Resources: http://landresources.montana.edu/
Montana Smartgrowth Coalition: http://mtsmartgrowth.org/
Montana Sport Fish Consumption Guidelines: http://www.dphhs.mt.gov/fish2005.pdf
Montana Water Center: http://www.watercenter.montana.edu
Montana Watercourse: http://www.mtwatercourse.org/WaterResources/resourcehome.htm
Montana Watershed Groups: http://water.montana.edu/watersheds/groups/
Montana Watershed Coordinating Council: http://water.montana.edu/watersheds/default.asp
Montana Wetland Legacy: http://www.wetlandslegacy.org/
Natural Heritage Program (NHP): http://nhp.nris.state.mt.us/
Natural Heritage Program (Aquatics): http://nhp.nris.state.mt.us/aquatics/default.asp
Natural Heritage Program (Wetlands):
http://nhp.nris.state.mt.us/Community/wetlands/default.asp
NHP Guide to NWI Types and Functions:
http://nhp.nris.state.mt.us/Community/wetlands/NWI/NWI_Guide.asp
NHP Wetland Assessments (many on BLM): http://nhp.nris.state.mt.us/reports.asp#ecology
Stream-Riparian Mgt:
http://www.animalrangeextension.montana.edu/riparianmgt/supplement/pg5_edu_resources.htm
Undaunted Stewardship: http://www.undauntedstewardship.com.

University of Montana College of Forestry and Conservation: http://www.forestry.umt.edu/
Water Quality BMPs for Montana's Forests' Manual:
http://dnrc.mt.gov/forestry/Assistance/Practices/Documents/2001WaterQualityBMPGuide.pdf
The Western Transportation Institute (WTI): http://www.coe.montana.edu/wti/

Professional Societies
Alberta Riparian Habitat Management: http://www.cowsandfish.org/
American Fisheries Society – Montana: http://www.fisheries.org/units/AFSmontana/
American Institute of Hydrology: http://www.aihydro.org/
Association of State Wetland Managers: http://www.aswm.org/
AWRA (MT): http://www.awra.org/state/montana/index.htm
Geological Society of America: http://www.geosociety.org/
Society for Range Management: http://www.rangelands.org/srm.shtml
Soil and Water Conservation Society: http://www.swcs.org/
Soil Science Society of America: http://www.soils.org/

Climate
American Tree Farm System: http://www.treefarmsystem.org/
Climate and Hydrology Database (USFS): http://www.fsl.orst.edu/climhy/
Climate Change: http://www.epa.gov/climatechange or www.mtclimatechange.us
Current Snow- Precipitation: http://www.wcc.nrcs.usda.gov/snow/update.html
Forest Stewardship Council: http://www.fscus.org/
National Water and Climate Center: http://www.wcc.nrcs.usda.gov/
National Climate Center: http://www.ncdc.noaa.gov/oa/ncdc.html
National Weather Service – Hydrologic Information: http://www.nws.noaa.gov/oh/hic/
NWS Satellite Imagery: http://www.wrh.noaa.gov/satellite/index.php?wfo=byz
NOAA Drought Center: http://www.drought.noaa.gov/
RAW Station Data: http://www.raws.dri.edu/index.html
Spatial Climate Analysis Center: http://www.ocs.orst.edu/prism/
High Plains Climate Center: http://www.hprcc.unl.edu/
Western Re gional Climate Center: http://www.wrcc.dri.edu/
Historical Climate: http://www.wrcc.dri.edu/CLIMATEDATA.html
Western Precipitation Frequency Maps: http://www.wrcc.dri.edu/pcpnfreq.html
Montana Drought Resources: http://drought.mt.gov/
Montana Climate Office: http://climate.ntsg.umt.edu/index.html
Montana Climate Summaries: http://www.wrcc.dri.edu/summary/climsmmt.html
Montana Snow and Precipitation: http://www.mt.nrcs.usda.gov/snow/data/
Montana Snow Survey Program: http://www.mt.nrcs.usda.gov/snow/index.html

Restoration
Aberdeen Plant Materials/Riparian Restoration:http://plant-materials.nrcs.usda.gov/idpmc/riparian.html
Center for Riverine Science and Stream Re-naturalization: http://www.umt.edu/rivercenter/
Center for Watershed Protection: http://www.cwp.org/
Future Fisheries: http://fwp.mt.gov/habitat/futurefisheries/content.asp

National River Restoration Science Synthesis:
http://www.nrrss.umd.edu/NRRSS_USEFUL_LINKS.htm
Pacific Northwest Direct Seed Association: http://www.directseed.org
Restoring Rivers: http://www.restoringrivers.org/
River Restoration Northwest: http://rrnw.org/index.htm
Stream Restoration Net: http://www.nced.umn.edu/Stream_Restoration.html
Stream Corridor Restoration: http://www.nrcs.usda.gov/technical/stream_restoration/
US Fish and Wildlife Service: http://www.r6.fws.gov/pfw/r6pfw2h.htm
WA State Aquatic habitat Guidelines: http://www.wdfw.wa.gov/hab/ahg/index.htm
Wild Fish Habitat Initiative: http://wildfish.montana.edu/resources/default.htm

Other
Conservation Tillage: http://www.ctic.purdue.edu
Educating Young People: http://www.uwex.edu/erc/eypaw/
Direct Seed: www.directseed.org/
Hydrology Tools (inc. Mannings): http://www.sd-w.com/civil/mannings_formula.html
Digital Library for Earth System Education: http://www.dlese.org/library/index.jsp
Low Impact Development (LID) Center: http://lid-stormwater.net/index.htm
Montana River Action: http://www.montanariveraction.org/
Native Fish Habitat Conservation Plan by Plum Creek Timber Company:
http://www.fws.gov/idahoes/PlumCr/NFHCP.htm
National Agriculture Statistics Database: http://www.nass.usda.gov
Organic Farming: http://www.aeromt.org or http://www.mt.nrcs.usda.gov/technical/organic
Pollution Locator (find pollutants for an area): http://www.scorecard.org/env-releases/water/index.tcl
Research in Watersheds Conference: http://www.tucson.ars.ag.gov/unit/ICRW.htm
Stream Line Watershed Mgt Bulletin: http://www.forrex.org/streamline/streamline.asp
Stream Morphology Tools: http://www.dnr.state.oh.us/soilandwater/streammorphology.htm
Terraserver (air photos): http://www.terraserver.microsoft.com/
Topozone (maps): http://www.topozone.com/
Understanding the CWA: http://www.cleanwateract.org./
U.S. Green Building Council (USGBC): http://www.usgbc.org/
Washington State Education, Environmental and Economic issues:
http://www.e3washington.org/
Wildland Hydrology: http://www.wildlandhydrology.com/
Yellowstone Business Partnership: http://www.yellowstonebusiness.org/.

APPENDICES

Appendix A – Best Management Practices for Water Quality Protection

Appendix B – Ground-Water Quality Strategy for the Montana Nonpoint Source Management Plan

Appendix C – Cooperators and Programs Addressing Nonpoint Source Pollution

Appendix D – DEQ-MWCB Priority Site List

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Appendix H – EPA's Nine Key NPS Plan Elements and "Crosswalk" to Montana NPS Plan

Appendix I – Response to Public Comment

Appendix J – Glossary and Acronym List

REFERENCES

Allan, Catherine, Allan Curtis, George Stankey and Bruce Shindler. 2006. Adaptive Management and Watersheds a Social Science Perspective. Paper presented at the Adaptive Management of Water Resources: AWRA Summer Specialty Conference, June 26-28, in Missoula, Montana.

Alt, Kurt L.; Michael R. Frisina and Frederick J. King. 1992. Coordinated Management of Elk and Cattle, A Perspective – Wall Creek Wildlife Management Area. *Rangelands 14(1):*12-15.

American Farmland Trust. 2005. *Rocky Mountain Agricultural Landowners Guide to Conservation and Sustainability*. Northampton, MA: American Farmland Trust. http://farmlandinfo.org/documents/30427/FINAL_Rocky_Mountain_Guide.pdf

Arizona Department of Environmental Quality. 2003. *Arizona's Nonpoint Source State Management Plan Five-Year Plan 2003-2008*. Phoenix, AZ: http://www.azdeq.gov/environ/water/watershed/download/final5.pdf

Bengeyfield, P., and Dan Svoboda. 1998. Determining Allowable Use Levels for Livestock Movement in Riparian Areas. Paper presented at the Rangeland Management and Water Resources Symposium (AWRA) on May 27-29, Reno, NV.

Bengeyfield, Pete. 2005. Quantifying the Forest-Wide Effects of Livestock Grazing on E Stream Types. (in press).

Bengeyfield, Pete. 2006. Managing Cows with Streams in Mind. *Rangelands*: Volume 28, Issue 1: 3-6.

Burroughs, E. R. Jr., and J. G. King. 1989. Reduction of Soil Erosion on Forest Roads. General Technical Report INT – 264. Ogden, UT: USDA Forest Service, Intermountain Research Station.

Burnett, Jill. 2006. Forestry Commission Scotland Greenhouse Gas Emissions Comparison Carbon Benefits of Timber in Construction. ECCM-EM-196-2006. Edinburgh, Scotland: The Edinburgh Centre for Carbon Management

Castelle, A.J., C. Conolly, M. Emers, E.D. Metz, S. Meyer, M. Witter, S. Mauermann, T. Erickson,S.S. Cooke. 1992. Wetland Buffers: Use and Effectiveness. Adolfson Associates, Inc., Shorelands and Coastal Zone Management Program, Olympia, WA: Washington Department of Ecology, Pub. No. 92-10.

Clausen, Becky. 2006. Monitoring Human Use in a Remote Alaskan Watershed. *The Volunteer Monitor* Volume 18, No. 2: 1-5.

Confluence Consulting, Inc., DTM Consulting, Inc., Applied Geomorphology, Inc., Blackfoot Challenge Habitat and Water Quality Restoration Committee, and Montana DEQ. 2004. Blackfoot Headwaters Planning Area Water Quality and Habitat Restoration Plan and TMDL for Sediment. Montana Department of Environmental Quality: Helena, MT.

Conservation Technology Center. www.ctic.purdue.edu. (accessed January 2, 2007.)

Dahl, Thomas E. 1990. *Wetlands losses in the United States 1780's to 1980's*. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center. http://www.npwrc.usgs.gov/resource/wetlands/wetloss/index.htm (Version 16JUL97)

Dane County Land and Water Resources Department. 2007. *Dane County's Erosion Control and Stormwater Management Manual, 2nd Edition*. Madison, WI: Dane County Land and Water Resources Department. http://www.danewaters.com/pdf/manual/ecsm_manual.pdf

Daumiller, Gerry. 2004. GIS Landscape Assessment Tool: Watershed Characterization for Factors that have an Impact on Wetlands. PowerPoint Presented at the Montana Wetland Monitoring and Assessment Conference, October 7, in Helena, Montana. http://www.deq.state.mt.us/wqinfo/wetlands/NRISwshedAssess.pdf

Environmental Defense. 2007. Global warming: Our coast-to-coast action campaign. Solutions. Vol 38, No.3: 6-7.

Fitch, L., B. Adams and K. O'Shaughnessy. 2003. Caring for the Green Zone: Riparian Areas and Grazing Management – Third Edition. Lethbridge, Alberta: Cows and Fish Program.

Flathead Lakers. 2006. Draft Critical Lands Project: Education & Outreach Plan 2005-2010. Polson, MT: Flathead Lakers.

Gale, J.A. and Osmond, D.L. 1995. Farmer Participation in Solving the Nonpoint Source Pollution Problem: The Rural Clean Water Program Experience. Washington, D.C.: U.S. Department of Agriculture, (Cooperative Agreement No. 93-EXCA-3-0241.)

Goodwin, Kim; Eric Miller. 2004. Riparian Weed Management. Bozeman, MT: MSU Extension Service.

Gucinski, H., M.J. Furniss, R.R. Ziemer, and M.H. Brookes. 2001. Forest Roads: a Synthesis of Scientific Information. Gen. Tech. Rep. PNW-GTR- 509. Portland, OR: U.S.D.A, Forest Service, Pacific Northwest Research Station.

Hashim, William A. and Bresler, Helen. 2005. Washington's Water Quality Management Plan to Control Nonpoint Sources of Pollution Volume 3. Olympia, WA: Washington Department of Ecology, (Publication Number 05-10-027).

Idaho Division of Environmental Quality. 1999. Idaho Nonpoint Source Management Plan. Boise, ID: Idaho Division of Environmental Quality.

Keegan, C. E., and T. A. Morgan. 2005. Montana's Timber and Forest Products Industry Situation, 2004. Missoula, Montana: University of Montana.

Kershner, Jeffrey L.; Eric K. Archer, Marc Coles-Ritchie, Ervin R. Cowley, Richard C. Henderson, Kim Kratz, Charles M. Quimby, David L. Turner, Linda C. Ulmer, Mark R. Vinson. 2004. Guide to Effective Monitoring of Aquatic and Riparian Resources. Fort Collins, CO: U.S. Department of Agriculture, Rocky Mountain Research Station.

Kinsella, S.R. 2005. Weathering the Change: Helping Trout in the West Survive the Impacts of Global Warming. Missoula, MT: Montana Trout Unlimited.

Kuntz, Bernie. 1993. Lands Legacy: Room with a View: Wall Creek Wildlife Management Area. Montana Outdoors 24.4: 15-18.

Land & Water Consulting, Inc., Montana Department of Environmental Quality and Lake County Conservation District. 2004. Water Quality Protection Plan and TMDLs for the Swan Lake Watershed. Helena, MT: Department of Environmental Quality.

Leonard, S., G. Kinch, V. Elsbernd, M. Borman, S. Swanson. 1997. Riparian Area Management: Grazing Management for Riparian-Wetland Areas. Technical Reference 1737-14. Denver, CO: U.S. Department of Interior, Bureau of Land Management, National Applied Resource Sciences Center.

Low Impact Development Center. http://lid-storm water.net/. Last accessed May 8, 2007.

Luce, C.H., B.E. Rieman, J.B. Dunham, J.L. Clayton, J.G. King, T.A. Black. 2001. Incorporating Aquatic Ecology into Decisions on Prioritization of Road Decommissioning. Water Resources IMPACT 3: 8 – 12.

Mayer, P.M., S. K. Reynolds, Jr., and T. J. Canfield. 2005. Riparian Buffer Width, Vegetative Cover and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations. Washington, D.C.: U.S. Environmental Protection Agency. (EPA/600/R-05/118.)

McGreer, D.J., B. Sugden, and D. Schult. 1998. Surface Erosion and Mass Wasting Assessment and Management Strategies for Plum Creek's Native Fish habitat Conservation Plan. Technical Report #3. Columbia Falls, MT: Plum Creek Timber Company.

Meitl, Joan and Todd Maguire. 2003. Compendium of Best Management Practices to Control Polluted Runoff: A Source Book. Boise, ID: Idaho Department of Environmental Quality.

Miller, Kathleen (Kate) and Joseph Meek. 2006. Helena Valley Ground Water: Pharmaceuticals, Personal Care Products, Endocrine Disruptors (PPCPs) and Microbial Indicators of Fecal Contamination. Helena, MT: Montana Department of Environmental Quality.

Montana Agriculture Statistics Service. www.nass.usda.gov. Last accessed January 12, 2006.

Montana Department of Environmental Quality. 2000. Strategy for Improving Water Quality Compliance from Concentrated Animal Feeding Operations. Helena, MT: Montana Department of Environmental Quality.

Montana Department of Environmental Quality. 2003. Water Quality Restoration Plan and Total Maximum Daily Loads for the Upper Lolo Creek TMDL Planning Area. Helena, MT: Montana Department of Environmental Quality.

Montana Department of Environmental Quality. 2004a. *Circular DEQ 4, Montana Standards for Subsurface Wastewater Treatment Systems*. Helena, MT: Montana Department of Environmental Quality. http://www.deq.mt.gov/wqinfo/Circulars/DEQ42004Edition.pdf

Montana Department of Environmental Quality. 2004b. *Water Quality Protection Plan and TMDLs for the Swan Lake Watershed.* Helena, MT: Montana Department of Environmental Quality. http://www.deq.mt.gov/wqinfo/TMDL/finalReports.asp.

Montana Department of Environmental Quality. 2004c. Standard Operating Procedures Water Quality Assessment Process and Methods-SOP WQPBMQM-001. Helena, MT: Montana Department of Environmental Quality.

Montana Department of Environmental Quality. 2005a. Big Spring Creek Watershed Water Quality Restoration Plan and Total Maximum Daily Loads. Helena, MT: Montana Department of Environmental Quality.

Montana Department of Environmental Quality. 2005b. *Grave Creek Watershed Water Quality and Habitat Restoration Plan and Sediment Total Maximum Daily Loads.* Montana DEQ, Helena, MT. http://www.deq.mt.gov/wqinfo/TMDL/finalReports.asp.

Montana Department of Environmental Quality. 2005c. Montana Demonstration Program Pilot (WDP) Work Plan. Helena, MT: Montana Department of Environmental Quality.

Montana Department of Environmental Quality. 2005d. *Montana Wetland Rapid Assessment Guidebook*. Helena, MT: Montana Department of Environmental Quality. http://www.deq.state.mt.us/wqinfo/Wetlands/DraftWetRapidAssForm.asp.

Montana Department of Environmental Quality. 2005e. Water Quality Restoration Plan and Total Maximum Daily Load (TMDL) for the Bobtail Creek Watershed. Helena, MT: Montana Department of Environmental Quality.

Montana Department of Environmental Quality. 2005f. Procedures Manual. Helena, MT: Montana Department of Environmental Quality.

Montana Department of Environmental Quality. 2006. *Integrated 303(d)/305(b) Water Quality Report for Montana.* Helena, MT: Montana Department of Environmental Quality. http://www.deq.mt.gov/CWAIC/wqrep/2006/FINAL_2006_MT_IR.pdf.

Montana Department of Fish, Wildlife and Parks. 1999. Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana. Helena, MT: Montana Fish, Wildlife and Parks.

Montana Department of Fish, Wildlife and Parks. 2005. Montana Statewide Comprehensive Outdoor Recreation Plan (SCORP), Helena, MT: Montana Fish, Wildlife, and Parks.

Montana Department of Natural Resources and Conservation. 1999. Best Management Practices for Grazing; Montana. Conservation Districts Bureau, DNRC. Helena, MT.

Montana Department of Natural Resources and Conservation. 2004. Best Management Practices for Forestry in Montana. Helena, MT: Montana Department of Natural Resources and Conservation.

Montana Department of Natural Resources and Conservation. 2005. *2005 Annual Report.* Helena, MT: Montana Department of Natural Resources and Conservation. http://dnrc.mt.gov/About_Us/publications/2005/2005_AR.pdf

Montana Department of Natural Resources and Conservation. 2006. Montana Forestry Best Management Practices Monitoring, 2006 Forest BMP Report. Missoula, MT: Montana Department of Natural Resources and Conservation, Forestry Division. http://dnrc.mt.gov/forestry/Assistance/Practices/Documents/06BMPaudit.pdf.

Montana Department of Public Health and Human Services. 2005. *2005 Montana Sport Fish Consumption Guidelines.* Helena, MT: Montana Department of Public Health and Human Services. http://www.dphhs.mt.gov/fish2005.pdf

Montana Department of Transportation. 2005. Design Consideration for Permanent Erosion Control Features to Reduce Sediment Transport. Helena, MT: Montana Department of Transportation.

Montana Natural Heritage Program. 2006. Work plan Year 1 for Wetland Mapping and Assessment. Montana Natural Heritage Program. Helena, Montana: Montana Natural Heritage Program.

Montana Salinity Control Association. N.D. Salinity Control in Montana (Brochure). Conrad, MT: Montana Salinity Control Association.

Montana Watercourse. 1996. Headwaters to a Continent. Bozeman, MT: Montana Watercourse.

Montana Watercourse, Montana DEQ, and Montana Audubon. 2003. Planning Guide for Protecting Montana's Wetland and Riparian Areas. Bozeman, MT: Montana State University.

Montana Watercourse. 2007. Volunteer Water Monitoring Guidebook. Bozeman, MT: Montana State University.

Montana Wood Products Association, 2005. *Forest Facts*. Helena, MT: Montana Wood Products Association. http://www.montanaforests.com/forests/forest_info.html.

Mosley, Jeffrey C.; Philip S. Cook, Amber J. Griffis, and Jay O'Laughlin, 1997. Guidelines for Managing Cattle Grazing in Riparian Areas to Protect Water Quality: Review of Research and Best Management Practices Policy Idaho Forest, Wildlife and Range policy Analysis Group Report #15. Moscow, ID: University of Idaho.

National Atlas of the United States®. http://nationalatlas.gov/atlasftp.html?openChapters=chpwater#chpwater.

National Council for Air and Stream Improvement Forest Watershed Task Group. 2003. Forest Roads and Aquatic Ecosystems: a Review of Causes, Effects, and Management Practices. Triangle Park, North Carolina: National Council for Air and Stream Improvement.

Natural Resource Information System. 1998. *Montana Ground-Water Atlas*. Washington, D.C.: Natural Resource Information System. http://nris.mt.gov/wis/pdf/gwatlas/mtgwa.pdf

Natural Resource Information System's Montana Geographic Information. http://nris.mt.gov/gis/default.asp. (accessed April 15, 2007).

North Dakota Department of Health, Nonpoint Source Pollution. 1999. North Dakota Nonpoint Source Pollution Management Program Plan. Bismarck, ND: North Dakota Department of Health.

Noson, A.C. and R.L. Hutto. 2005. *Using Birds Indices of Biological Integrity to Assess the Condition of Wetlands in Montana*. Missoula, Montana: Avian Science Center, University of Montana. Http://www.deq.state.mt.us/wqinfo/wetlands/final%20Report.Noson.v2.pdf

Plum Creek Timber Co, National Marine Fisheries, U.S. Fish and Wildlife Service. 2000. *Native Fish Habitat Conservation Plan.* Boise, ID: U.S. Department of the Interior. http://www.fws.gov/idahoes/PlumCr/NFHCP.htm

Rieman, Bruce, Jason Dunham, and James Clayton. 2000. Emerging concepts for management of river ecosystems and challenges to applied integration of physical and biological sciences in the Pacific Northwest, USA.. *International Journal of Basin Management*. Vol. 4, No.2: 85-97.

River Network. 2002. Fact Sheet: You can make a difference every day! How much is up to you. Portland, OR: River Network.

Stimson, Eric. 2005. *Update: Snowplow Sidecast Experiment.* Helena, MT: Montana Department of Transportation, Environmental Sciences Bureau. http://www.mdt.mt.gov/publications/docs/brochures/env/snowplow_sidecast.pdf

Sugden, Brian D. and Scott W. Woods. 2007. Sediment Production From Forest Roads in Western Montana. *Journal of the American Water Resources Association*. Vol. 43, No. 1: 193-206.

Thompson, Steve. 2002. “State-of-the-Art Conservation and Forest Management Practices”, presented at the 2002 Governor's Conference on the Future of Montana's Forests, May 13-14, in Bozeman, MT.

Tri-State Water Council. 2005. *Septic System Impact on Surface Waters: A Review for the Inland Northwest*. Sandpoint, ID: Tri-State Water Quality Council. http://www.tristatecouncil.org/documents/05septic_system_impacts.pdf.

University of Minnesota Extension Service. 2005. Is My Barn Eco-friendly? Minneapolis, MN: University of Minnesota.

U.S. Census Bureau. “American Fact Finder.” 2007. http://factfinder.census.gov/home/saff/main.html?_lang=en. (accessed April 15, 2007).

U.S. Department of Interior- Bureau of Land Management. 1998. Successful Strategies for Grazing Cattle in Riparian Zones. Riparian Technical Bulletin No. 4. Grenough, MT: Montana Forest Conservation Experiment Station.

U.S. Department of Interior- BLM, USDA- NRCS, USDA. 2006. Forest Service, Montana/Dakotas Interagency Riparian Cadre. 2006. Montana Riparian Information. Washington, D.C.: Creeks and Communities.

U.S. Department of Agriculture-Forest Service. 1997. Riparian Area Management. Grazing Management for Riparian Wetland Areas. TR 1737-14. Washington, D.C.: USDA-Forest Service.

U.S. Department of Agriculture Forest Service. 1998. Riparian Area Management. A Users Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. Washington, D.C.: USDA-Forest Service.

U.S. Department of Agriculture Forest Service. 2005. Forest Plan Direction. Sonora, CA: USDA Forest Service, Pacific Southwest Region. http://www.fs.fed.us/r5/stanislaus/publications/forest-plan-direction-07-2005.pdf

U.S. Department of Agriculture Forest Service. 2007. *Forest Service Handbook 2209.22 Soil and Water Conservation Practices Handbook – R1/R4 Amendment #1*, http://www.fs.fed.us/dirindexhome/field/r4/fsh/2509.22/2509.22_10.txtn (Accessed March 29, 2007)

U.S. Department of Agriculture Forest Service, Flathead National Forest. 2003. Watershed Restoration Plan for Big Creek, North Fork of the Flathead River. Helena, MT: Department of Environmental Quality.

U.S. Department of Agriculture National Agricultural Statistics Service. www.nass.usda.gov. Last accessed January 12, 2006.

U.S. Department of Agriculture Natural Resource Conservation Service. 2005. Livestock Production and Water Quality in Montana. Washington, D.C.

U.S. Environmental Protection Agency. 1993a. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. Washington, D.C.: U.S. Environmental Protection Agency, Office of Water.

U.S. Environmental Protection Agency. 1993b. Livestock Grazing on Western Riparian Areas. Washington, D.C: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2002. Community Culture and the Environment: A Guide to Understanding a Sense of Place Washington, D.C: U.S. Environmental Protection Agency. (EPA 842-B-01-003).

U.S. Environmental Protection Agency. 2003a. National Management Measures for the Control of Nonpoint Pollution from Agriculture Washington, D.C.: U.S. Environmental Protection Agency. (EPA-841-B-03-004).

U.S. Environmental Protection Agency. 2003b. Proceedings of the 3rd National Conference: Nonpoint Source Pollution Information & Education Programs. Washington, D.C.: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2003c. Getting In Step: A Guide for Conducting Watershed Outreach Campaigns, Washington, D.C.: U.S. Environmental Protection Agency. (EPA 841-B-03-002).

U.S. Environmental Protection Agency. 2004. Water Quality Assessment and TMDL for Flathead River Headwaters Planning Area. Helena, MT: Montana Department of Environmental Quality.

U.S. Environmental Protection Agency. 2005a. National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution. Washington, D.C.: U.S. Environmental Protection Agency. (EPA 841-B-05-003).

U.S. Environmental Protection Agency. 2005b. *National Management Measures to Control Nonpoint Source Pollution from Urban Areas.* Washington, D.C.:U.S. Environmental Protection Agency. (EPA 841-B-05-004). http://www.epa.gov/owm/septic/pubs/urban_guidance.pdf.

U.S. Environmental Protection Agency. 2006. EPA Watershed Training Opportunities. Washington, D.C.: U.S. Environmental Protection Agency. (EPA 841-B-06-001).

U.S. Environmental Protection Agency. Safe Drinking Water Information System Database. http://www.epa.gov/safewater/sdwisfed/sdwis.htm

U.S. Forest Service. 1996. Status of the Interior Columbia Basin: Summary of Scientific Findings. Gen. Tech. Rep. PNW-GTR-385. Portland, OR: U.S.D.A. Forest Service, Pacific Northwest Research Station.

U.S. Forest Service. 2006. Proposed Land Management Plan PACFISH/INFISH Crosswalk. Oct. 30, 2006 version. Missoula, MT: US Forest Service, Region 1.

U.S. Forest Service. 2007. Unpublished Stream Crossing Data. Missoula, MT: Forest Service, Region 1.

U.S. Geological Survey. 2000. Estimated Water Use in the United States. National Atlas of the United States®. http://nationalatlas.gov/atlasftp.html?openChapters=chpwater#chpwater. Last accessed May 8, 2007.

Vogel, Michael P. 2005. *Septic Tank and Drainfield Operation and Maintenance.* Bozeman, MT: Montana State University. http://www.montana.edu/wwwpb/pubs/mt9401.pdf.

Western, S. 2005. A New Green Revolution. *High Country News.* December 26.

Wilbur, Jack. 2006. Draft: Getting your feet wet with Social Marketing, A Social Marketing Guide for Watershed Programs. Salt Lake City, UT: Utah Department of Agriculture and Food.

Winward, Alma. 2000. Monitoring the Vegetation Resources in Riparian Areas. Fort Collins, CO: U.S. Forest Service, Rocky Mountain Research Station.

Winter, T.C., W. Harvey, O.L. Franke, and W.M. Alley. 1998. *Ground Water and Surface Water, a Single Resourc*e. Washington, D.C.: United States Geological Survey. http://pubs.usgs.gov/circ/circ1139/

Wright David J. 1995. *Inland Native Fish (INFISH) Strategy: Notice of Decision on the INFISH Strategy Environmental Assessment and Finding of No Significant Impact.* FR Doc. 95-19228. Federal Register, Volume 60, Number 150: 39927-39928. wais.access.gpo.gov.

Wyoming Department of Environmental Quality. 2000. Wyoming Nonpoint Source Management Plan Update. Cheyenne, WY: Wyoming Department of Environmental Quality.

Wyoming Game and Fish Department. 1993. The Role of Beaver in Riparian Habitat Management. *Habitat Extension Bulletin*: No. 38.

Zeedyk, Bill. 2006. Water Harvesting From Low-Standard Rural Roads. Santa Fe, NM: Quivira Coalition